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A

TREATISE

OF THE

Natural Grounds, and *Principles*

OF

HARMONY.

By WILLIAM HOLDER, D. D. Fellow of the *Royal Society*, and late Sub-Dean of their MAJESTY's *Chapel Royal.*

To which is Added, by way of *APPENDIX:*

RULES for Playing a *Thorow-Baſs*; with Variety of *Proper Leſſons*, *Fuges*, and *Examples* to Explain the ſaid RULES. Alſo Directions for Tuning an *Harpſichord* or *Spinnet.*

By the late Mr. GODFREY KELLER.

With ſeveral new Examples, which before were wanting, the better to explain ſome Paſſages in the former Impreſſions.

The whole being Revis'd, and Corrected from many groſs Miſtakes committed in the firſt Publication of theſe Rules.

LONDON:

Printed by W. PEARSON, over againſt *Wright*'s *Coffee-Houſe in Alderſgate-ſtreet*; for J. WILCOX in *Little-Britain*; and T. OSBORNE in *Gray's-Inn.* 1731.

THE PUBLISHER, TO THE READER.

THE Intention of Publiſhing Mr. Keller's *Rules, (by way of Appendix to Dr.* Holder's *Book) was chiefly to reſcue them from many Miſtakes and Errors, which were occaſioned by the Ignorance of the firſt Publiſhers of them on Plates, which wou'd never have happen'd, if the judicious Author had liv'd to have corrected the Plates himſelf: Nor cou'd he have ſuffer'd thoſe Examples, which are now Added, to have been wanting, the better to explain ſome of the ſaid Rules, which before were only printed in Figures, without a proper Illuſtration of the ſame in Muſical Notes; as is evident by many Inſtances of the ſame kind throughout the ſaid Work.*

And as this Book may fall into the Hands of ſome, who have (not only a Taſt for Dr. Holder's *Treatiſe, but alſo) a Genius for Compoſing as well as for Playing a Through Baſs; it is not improper to Obſerve, that there are many excellent Rules contain'd in it, which will be found of great Advantage to young Compoſers, as well as to thoſe who practiſe a Through Baſs; eſpecially with Regard to the various Ways of taking Diſcords, which is one of the moſt difficult Parts of Compoſition.*

And I humbly preſume, that for theſe Reaſons, it will become at leaſt as Uſeful and Inſtructive, as any thing that has hitherto been Publiſh'd of this kind.

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Rules

THE

Natural Grounds and Principles

OF

HARMONY.

The INTRODUCTION.

HARMONY *consists of Causes, Natural and Artificial, as of Matter and Form. The Material Part of it, is* Sound *or* Voice. *The Formal Part is, The Disposition of Sound or Voice into Harmony; which requires, as a preparative Cause, skilful Composition; and, as an immediate Efficient, Artful Performance.*

The former Part, viz. *The Matter, lies deep in Nature, and requires much Research into Natural Philosophy to unfold it; to find how* Sounds *are made, and how they are first fitted by Nature for Harmony, before they be disposed by Art: Both together make Harmony compleat.*

Harmony, then, results from practick Musick, and is made by the Natural and Artificial Agreement of different Sounds, (viz. *Grave and Acute) by which the Sense of Hearing is delighted.*

This is proper in Symphony, i. e. *Consent of more Voices in different Tones; but is found also in solitary Musick of one Voice, by the Observation and Expectation of the Ear, comparing the Habitudes of the following Notes to those which did precede.*

Now the Theory in Natural Philosophy, of the Grounds and Reasons of this Agreement of Sounds, and consequent Delight and Pleasure of the Ear, (leaving the Management of these Sounds to the Masters of Harmonick Composure, and the skilful Artists in Performance) is the Subject of this Discourse. The Design whereof (for the Sake and Service of all Lovers of Musick, and particularly the Gentlemen of Their Majesty's Chapel Royal) is, to lay down these Principles as short, and intelligible, as the Subject Matter will bear.

Where the first thing Necessary, is a Consideration of somewhat of the Nature of Sound *in General; and then, more particularly, of Harmonick Sounds,* &c.

CHAP.

CHAP. I.

Of Sound *in General.*

IN General to pass by what is not pertinent to this Design) Sence and Experience confirm these following Properties of Sound.

1. ALL Sound is made by Motion, *viz.* by Percussion with Collision of the Air.

2. THAT Sound may be propagated, and carried to Distance, it requires a *Medium* by which to pass.

3. THIS *Medium* (to our Purpose) is Air.

4. AS far as Sound is propagated along the *Medium*; so far also the Motion passeth. For (if we may not say that the Motion and Sound are one and the same thing,

yet at leaſt) it is neceſſarily conſequent, that if the Motion ceaſe, the Sound muſt alſo ceaſe.

5. SOUND, where it meets with no Obſtacle, paſſeth in a Sphere of the *Medium*, greater or leſs, according to the Force and Greatneſs of the Sound; of which Sphere the ſonorous Body is as the Centre.

6. SOUND, ſo far as it reacheth, paſſeth the *Medium*, not in an Inſtant, but in a certain uniform Degree of Velocity, calculated by *Gaſſendus*, to be about the rate of 276 Paces, in the ſpace of a ſecond Minute of an Hour. And where it meets with any Obſtacle, it is ſubject to the Laws of Reflexion, which is the Cauſe of Echo's Meliorations, and Augmentations of Sound.

7. SOUND, *i. e.* the Motion of Sound, or ſounding Motion, is carried through the *Medium* or Sphere of Activity, with an *Impetus* or Force, which ſhakes the free *Medium*, and ſtrikes and ſhakes every Obſtacle it meets with, more or leſs, according to the vehemency of the Sound, and Nature of the Obſtacle, and Nearneſs of it to the Centre, or ſonorous Body. Thus the

the impetuous Motions of the Sound of Thunder, or of a Canon, ſhake all before it, even to the breaking of Glaſs Windows, *&c.*

8. THE Parts of the ſounding Body are moved with a Motion of Trembling, or Vibration, as is evident in a Bell or Pipe, and moſt manifeſt in the ſtring of a Muſical Inſtrument.

9. THIS Trembling, or Vibration, is either equal and uniform, or elſe unequal and irregular; and again, ſwifter or ſlower, according to the Conſtitution of the ſonorous Body, and Quality and Manner of of Percuſſion; and from hence ariſe Differences of Sounds.

10. THE Trembling, or Vibration of the ſonorous Body, by which the particular Sound is conſtituted and diſcriminated, is impreſſed upon, and carried along the *Medium* in the ſame Figure and Meaſure, otherwiſe it would not be the ſame Sound, when it arrives at a more diſtant Ear, *i. e.* the Tremblings and Vibrations (which may be called Undulations) of the Air or *Medium*, are all along of the ſame Velocity and Figure, with thoſe of the ſonorous Body, by which they are cauſed.

THE Differences of Sounds, as of one Voice from another, *&c.* (beſides the Difference of Tune, which is cauſed by the Difference of Vibrations) ariſe from the Conſtitution and Figure, and other Accidents of the ſonorous Body.

II. IF the ſonorous Body be requiſitely conſtituted, *i. e.* of Parts ſolid, or tenſe, and regular, fit, being ſtruck, to receive and expreſs the tremulous Motions of Sound, equally and ſwiftly, then it will render a certain and even Harmonical Tone or Tune, received with Pleaſure, and judged and meaſured by the Ear: Otherwiſe it will produce an obtuſe or uneven Sound, not giving any certain or diſcernable Tune.

NOW this Tune, or Tuneable Sound, φθόγγος, i. e. φωνῆς πλῶσις ἐμμελὴς ἐπὶ μίαν τάσιν, An agreeable Cadence of Voice, at one Pitch or Tenſion. This Tuneable Sound (I ſay) as it is capable of other Tenſions towards Acuteneſs, or Gravity, *i. e.* the Tenſions greater or leſs, the Tune graver or more acute, *i. e.* lower or higher, is the firſt Matter or Element of Muſick. And this Harmonick Sound comes next to be conſidered.

CHAP.

CHAP. II.

Of Sound *Harmonick.*

THE firſt and great Principle upon which the Nature of Harmonical Sounds is to be found out and diſcovered, is this: That the Tune of a Note (to ſpeak in our vulgar Phraſe) is conſtituted by the Meaſure and Proportion of Vibrations of the ſonorous Body; I mean, of the Velocity of thoſe Vibrations in their Recourſes.

FOR, the frequenter the Vibrations are, the more Acute is the Tune; the ſlower and fewer they are in the ſame Space of Time, by ſo much the more Grave is the Tune. So that any given Note of a Tune, is made by one certain Meaſure of Velocity of Vibrations; *viz.* Such a certain Number of Courſes and Recourſes. *e. g.* of a Chord or String, in ſuch a certain Space of Time, doth conſtitute ſuch a certain determinate Tune. And all ſuch Sounds as are Uniſons, or of the ſame Tune with that given Note, though upon whatſoever different Bodies, (as *String*, *Bell*, *Pipe*, *Larynx*, &c.) are made with Vibrations or

Tremblings of thoſe Bodies, all equal each to the other: And whatſoever Tuneable Sound is more Acute, is made with Vibrations more ſwift; and whatſoever is more grave, is made with more ſlow Vibrations: And this is univerſally agreed upon, as moſt evident to Experience, and will be more manifeſt through the whole Theory.

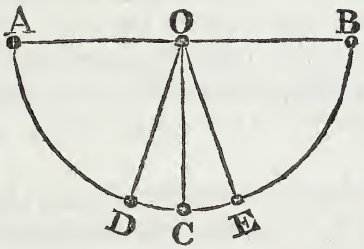
And, That the Continuance of the Sound in the ſame Tune, to the laſt, (as may be perceived in Wire-ſtrings, which being once ſtruck will hold their Sound long) depends upon the Equality of Time of the Vibrations, from the greateſt Range till they come to ceaſe: And this perfectly makes out the following Theory of Conſonancy, and Diſſonancy.

Some of the ancient *Greek* Authors of Muſick, took Notice of Vibrations: And that the ſwifter Vibrations cauſed Acuter, and the ſlower, graver Tones. And that the Mixture, or not Mixture of Motions creating ſeveral Intervals of Tune, was the Reaſon of their being Concord or Diſcord. And likewiſe, they found out the ſeveral Lengths of a Monochord, proportioned to the ſeveral Intervals of Harmonick Sounds: But they did not make out the Equality of Meaſure of Time, of the

Vi-

Vibrations laſt ſpoken of, neither could be prepared to anſwer ſuch Objections, as might be made againſt the Continuity of the ſameneſs of Tune, during the Continuance of the Sound of a *String*, or a *Bell* after it is ſtruck. Neither did any of them offer any Reaſons for the Proportions aſſigned, only it is ſaid, that *Pythagorus* found them out by Chance.

BUT now, Theſe (ſince the Acute *Galileo* hath obſerved, and diſcovered the Nature of *Pendulums)* are eaſy to be explained, which I ſhall do, premiſing ſome Conſideration of the Properties of the Motions of a *Pendulum.*



HANG a Plumbet *C* on a String or Wire, fixed at *O.* Bear *C* to *A:* Then let it range freely, and it will move toward *B*, and from thence ſwing back towards *A.* The Motion from *A* to *B*, I call the Courſe,

Courſe, and back from *B* to *A*, the Recourſe of the *Pendulum*, making almoſt a Semi-Circle, of which *O* is the Centre. Then ſuffering the *Pendulum* to move of itſelf, forwards and backwards, the Range of it will at very Courſe and Recourſe abate, and diminiſh by degrees, till it come to reſt perpendicular at *O C*.

Now that which *Galileo* firſt obſerved, was, that all the Courſes and Recourſes of the *Pendulum*, from the greateſt Range through all Degrees till it come to reſt, were made in equal Spaces of Time. That is, *e. g.* The Range between *A* and *B*, is made in the ſame Space of Time, with the Range between *D* and *E*; the Plumbet moving ſwifter between *A* and *B*, the greater Space; and ſlower between *D* and *E*, the leſſer; in ſuch Proportions, that the Motions between the Terms *A B* and *D E*, are performed in equal Space of Time.

And here it is to be Noted, that where ever in this Treatiſe, the ſwiftneſs or ſlowneſs of Vibrations is ſpoke of, it muſt be always underſtood of the frequency of their Courſes and Recourſes, and not of the Motion by which it paſſeth from one ſide to another. For it is true, that the ſame *Pendulum* under the ſame Velocity of Returns, moves

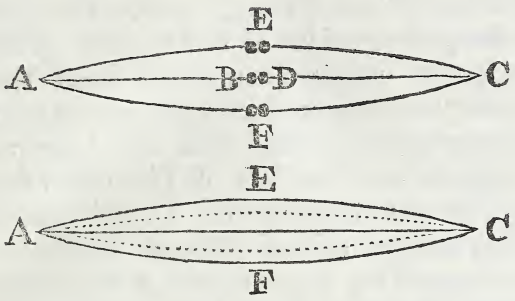
moves from one ſide to the other, with greater or leſs Velocity, according as the Range is, greater or leſs.

And hence it is, that the Librations of a *Pendulum* are become ſo excellent, and uſeful a Meaſure of Time; eſpecially when a ſecond Obſervation is added, that, as you ſhorten the *Pendulum*, by bringing *C* nearer to its Centre *O*, ſo the Librations will be made proportionably in a ſhorter Meaſure of Time, and the contrary if you lengthen it. And this is found to hold in a Duplicate proportion of length to Velocity. That is, the length quadrupled, will ſubduple the Velocity of Vibrations: And the Length ſubquadrupled, will duple the Vibrations, for the Proportion holds reciprocally. As you add to the length of the *Pendulum*, ſo you diminiſh the frequency of Vibrations, and increaſe them by ſhortning it.

Now therefore to make the Courſes of a *Pendulum* doubly ſwift, *i. e.* to move twice in the ſame Space of Time, in which it did before move once; you muſt ſubquadruple the Length of it, *i. e.* make the *Pendulum* but a quarter ſo long as it was before. And to make the Librations doubly ſlow, to paſs once in the Time they did

did paſs twice; you muſt quadruple the Length; make the *Pendulum* four Times as long as it was before, and ſo on in what Proportion you pleaſe.

Now to apply this to Muſick, make two *Pendulums*, *A B* and *C D*, faſten together the Plumbets *B* and *D*, and ſtretch them at length, (fixing the Centers *A* and *C*.) Then, being ſtruck, and put into Motion; the Vibrations, which before were diſtinct, made by *A B*, and *C D*, will now be united (as of one entire String) both backward and forward, between *E* and *F*. Which Vibrations (retaining the aforeſaid Analogy to a *Pendulum*) will be made in equal Spaces of Time, from the firſt to the laſt; *i. e.* from the greateſt Range to the leaſt, until they ceaſe. Now, this being a double *Pendulum*, to ſubduple the ſwiftneſs of the Vibrations, you do but double the length from *A* to *C*, which will be quadruple to *A B*. The lower Figure is the ſame with that above, only the Plummets taken off.



And here you have the Nature of the String of a Musical Instrument, resembling a double *Pendulum* moving upon two Centers, the Nut and the Bridge, and Vibrating with the greatest Range in the middle of its Length; and the Vibrations equal even to the last, which must make it keep the same Tune so long as it Sounds. And because it doth manifestly keep the same Tune to the last; it follows that the Vibrations are equal, confirming one another by two of our Senses; in that we see the Vibrations of a *Pendulum* move equally, and we hear the Tune of a String, when it is struck, continue the same.

The Measure of swiftness of Vibrations of the String or Chord, (as hath been said,) constitutes and determines the Tune, as to the Acuteness and Gravity of the Note which it sounds; And the lengthning or short-

ſhortning of the String, under the ſame Tenſion, determines the Meaſure of the Vibrations which it makes. And thus, Harmony comes under mathematical Calculations of Proportions, of the length of Chords, of the Meaſure of Time in Vibrations; of the Intervals of Tuned Sounds. As the length of one Chord to another, *Cæteris paribus*, I mean, being of the ſame Matter, thickneſs and tenſion; ſo is the Meaſure of the Time of their Vibrations. As the Time of Vibrations of one String to another, ſo is the Interval or Space of Acuteneſs or Gravity of the Tune of that one, to the Tune of the other: And conſequently, as the length is *(Cæteris paribus)* ſo is the determinate Tune.

And upon theſe Proportions in the Differences of Lengths of Vibrations, and of Acuteneſs and Gravity; I ſhall inſiſt all along in this Treatiſe, very largely and particularly, for the full Information of all ſuch ingenious Lovers of Muſick, as ſhall have the Curioſity to inquire into the Natural Cauſes of Harmony, and of the *Phænomena* which occurr therein, though otherwiſe, to the more learned in Muſick and Mathematical Proportions, all might be expreſſed very much ſhorter, and ſtill be more ſhortned by the help of Symbols.

And

And here we may fix our Foot: Concluding, that what is evident to Senſe, of the *Phænomena*, in a Chord, is equally (though not ſo diſcernably) true of the Motions of all other Bodies which render a tuneable Sound, as the Trembling of a *Bell* or *Trumpet*, the forming of the *Larynx* in our ſelves, and other Animals, the throat of Pipes and of thoſe of an Organ, *&c.* All of them in ſeveral Proportions ſenſibly trembling and impreſſing the like Undulations of the *Medium*, as is done by the ſeveral (more manifeſt) Vibrations of Strings or Chords.

In theſe other Bodies, laſt ſpoken of, we manifeſtly ſee the Reaſon of the Difference of the ſwiftneſs of their Vibrations (though we cannot ſo well meaſure them) from their Shape, and other Accidents in their Conſtitution; and chiefly from the Proportions of their Magnitudes; the Greater generally Vibrating ſlower, and the Leſs more ſwiftly, which give the Tunes accordingly. We ſee it in the Greatneſs of a String; a greater and thicker Chord will give a graver and lower Tone, than one that is more ſlender, of the ſame Tenſion and Length; but they may be made Uniſon by altering their Length and Tenſion.

Ten-

TENSION is proper to Chords or Strings (except you will account a *Drum* for a Muſical Inſtrument, which hath a Tenſion not in Length, but in the whole ſurface) as when we wind up, or let down the Strings, *i. e.* give them a greater or leſs Tenſion, in tuning a *Viol*, *Lute*, or *Harpſichord*, and is of great Concern, and may be meaſured by hanging Weights on the String to give it Tenſion but not eaſily, nor ſo certainly.

BUT the lengths of Chords (becauſe of their Analogy to a *Pendulum)* is chiefly conſidered, in the diſcovery of the Proportions which belong to Harmony, it being moſt eaſie to meaſure and deſign the Parts of a Monochord, in relation to the whole String; and therefore all Intervals in Harmony may firſt be deſcribed, and underſtood, by the Proportions of the length of Strings, and conſequently of their Vibrations. And it is for that Reaſon, that in this Treatiſe of the Grounds of Harmony, Chords come ſo much to be conſidered, rather than other ſounding Bodies, and thoſe, chiefly in their Proportions of Length. It is true, that in Wind-Inſtruments, there is a Regard to the Length of Pipes, but they are not ſo well accomodated (as our Chords) to be examined,

nei-

neither are their Vibrations, nor the measure of them so manifest.

THERE are some Musical Sounds which seem to be made, not by Vibrations but by Pulses as by whisking swiftly over some Silk or Camblet-stuffs, or over the Teeth of a Comb, which render a kind of Tune more Acute or Grave, according to the swiftness of the Motion. Here the Sound is made, not by Vibrations of the same Body, but by Percussion of several equal, and equidistant Bodies; as Threads of the Stuff, Teeth of the Comb passing over them with the same Velocity as Vibrations are made. It gives the same Modification to the Tune, and to the Undulations of the Air, as is done by Vibrations of the same Measure; the Multiplicity of Pulses or Percussions, answering the Multiplicity of Vibrations. I take this Notice of it, because others have done so; but I think it to be of no use in Musick.

APPENDIX.

Before I conclude this Chapter, *it may ſeem needful, better to confirm the Foundation we have laid, and give the* Reader *ſome more ample Satisfaction about the Motions and Meaſures of a* Pendulum, *and the Application of it to Harmonick Motion.*

FIRST then, it is manifeſt to Sence and Experience, and out of all diſpute; that the Courſes and Recourſes return ſooner or later, *i. e.* more or leſs frequently, according as the *Pendulum* is ſhortned, or made longer. And that the Proportion by which the Frequency increaſeth, is (at leaſt) very near duplicate, *viz.* of the length of the *Pendulum*, to the Number of Vibrations, but is in reverſe, *i. e.* as the Length encreaſeth, ſo the Vibrations decreaſe; and contrary, quadruple the Length, and the Vibrations will be ſubdupled. Subquadruple the Length, and the Vibrations will be dupled. And laſtly, that the Librations, the Courſes and Recourſes of the ſame *Pendulum*, are all made in equal Space of Time, or very near to it, from the greateſt Range to the leaſt.

leaſt. Now though the duplicate Proportion aſſigned, and the equality of Time, are a little called in queſtion, as not perfectly exact, though very near it; yet in a Monochord we find them perfectly agree, *viz* as to the length, Duple inſtead of Duplicate, becauſe a String faſtned at both ends is as a double *Pendulum*, each of which is quadrupled by dupling the whole String. And on this duple Proportion, depend all the Rations found in Harmony. And again, the Vibrations of a String are exactly equal, becauſe they continue to give the ſame Tune.

SUPPOSING then ſome little difference may ſometime ſeem to be found in either of theſe Motions of a *Pendulum*, yet the nearneſs to Truth is enough to ſupport our Foundation, by ſhewing what is intended by Nature, though it ſometimes meet with ſecret Obſtacles in the *Pendulum*, which it does not in a well made String. We may juſtly make ſome Allowance for the Accidents, and unſeen Cauſes, which happen to make ſome little Variations in Trials of Motion upon groſs Matter, and conſequently the like for nicer Experiments made upon the *Pendulum*. It is difficult to find exactly the determinate Point of the Plumbet, which regulates the Motions

of the *Pendulum*, and consigns its just length. Then observe the Varieties which happen through various sorts of Matter, upon which Experiments are made. *Mersennus* tells us, that heavier Weights of the same length move slower, so that whilst a Lead Plumbet makes 39 Vibrations, Cork or Wood will make at least 40.

AGAIN, that a stiff *Pendulum* vibrates more frequently, than that which hangs upon a Chord. So that a Bar of Iron, or Staff of Wood ought to be half as long again as the other, to make the Vibrations equal. Yet in each of these respectively to itself, you will find the duplicate Proportion and Equality of Vibration, or as near as may be. And (as to Equality) though in the Extreams of the Ranges of Librations, *viz.* the greatest compared to the least, there may (from unseen Causes) appear some Difference, yet there is no discernable Difference of the Time of Vibrations of a *Pendulum* in Ranges, that are near to one another, whether greater or less; which is the Case of the Ranges of the Vibration of a String being made in a very small Compass: And therefore the Librations of a *Pendulum*, limitted to a small Difference of Ranges, do well correspond with the Vibrations of a String.

As to Strings, the Whole of Harmony depends upon this experimented and unqueſtioned Truth, that Diapaſon is duple to its Uniſon, and conſequently Diapente is Seſquialterum, Diateſſeron Seſquitertium, &c. Yet if you happen to divide a faulty String of an Inſtrument, you will not find the Octave juſt in the Middle, nor the other Intervals in their due Proportion, which is no default in Nature, but the Matter we apply. A falſe String is that, which is thicker in one Part of its Length, than in another. The thicker Part naturally vibrates ſlower, and ſounds graver; the more ſlender Part vibrates ſwifter, and ſounds more acute. Thus whilſt two Sounds ſo near one another, are at once made upon the ſame String, they make a rough diſcording Jarr, being a hoarſe Tune mixed of both, more or leſs, as the String is more or leſs unequal: And if the thicker Part be next the Frets, then the Fret (for Example *D. F. H.* &c. in a Viol or Lute) will render the Tune of the Note too ſharp; and the contrary, if the ſlender Part of the String be next the Frets; becauſe in the former, the thicker Part is ſtopped, and the thinner ſounds more of the acuter Part of this unhappy Mixture: As in the later, the thicker Part is left to ſound the graver Tune, and thus the Fret

will give a wrong Tune though the Fault be not in the Fret, but in the String; which yet, by an unwary Experimenter, may happen to cauſe the *Sectio Canonis* to be called in queſtion, as well as the Meaſures of a *Pendulum* are diſputed.

But all this does not diſprove the Meaſures found out, and aſſigned to Harmonick Intervals, which are verified upon a true String or Wire as to their Lengths, and as to the Equality of Recourſes in their Vibrations, though *Pendulums* are thought to move ſlower in their leaſt Ranges; yet, as to Strings, in the very ſmall Ranges which they make, (which are much leſs in other Inſtruments, or ſounding Bodies) I need add no more than this, that the Continuance of the ſame Tune to the laſt, after a Chord is ſtruck, and the continued Motion in leſs Vibrations of a ſympathizing String, during the Continuance of greater Vibrations of the String which is ſtruck, do either of them ſufficiently demonſtrate, that thoſe greater or leſs Vibrations, are both made in the ſame Meaſure of Time, according to their Proportions, keeping exact Pace with each other. Otherwiſe; In the former, the Tune would ſenſibly alter, and in the latter, the ſympathizing String could not be continued

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in its Motion. This was not so well concluded, till the late Discoveries of the *Pendulum* gave light to it.

THERE is one thing more which I must not omit. That the Motions of a *Pendulum*, may seem not so proper to explicate the Motions of a String, because the said Motions depend upon differing Principles, *viz.* those of a *Pendulum* upon Gravity; those of a String upon Elasticity. I shall therefore endeavour to shew, how the Motions of a *Pendulum*, agree with those of a Spring, and how properly the Explication of the Vibrations of a String, is deduced from the Properties of a *Pendulum*.

THE Elastick power of a Spring, in a Body indued with Elasticity, seems to be nothing else, but a natural Propension and Endeavour of that Body, forced out of its own Place, or Posture, to restore it self again into its former, more easie and natural Posture of Rest. And this is found in several Sorts of Bodies, and makes different Cases, of which I shall mention some.

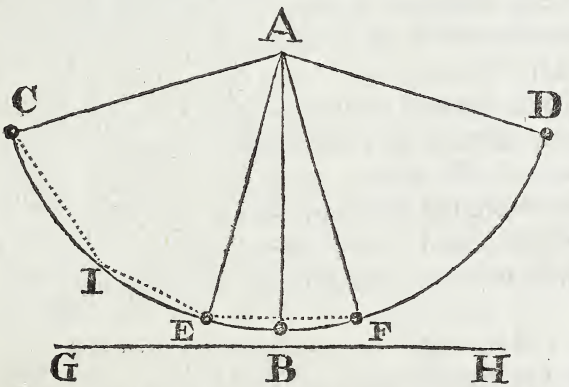
IF the Violence be by Compression, forcing a Body into less room than it naturally requires; then the Endeavour of Re-

ſtitution, is by Dilatation to gain room enough. Thus Air may be compreſſed into leſs Space, and then will have a great Elaſticity, and ſtruggle to gain its room. Thus, if you ſqueeze a dry Sponge, it will naturally, when you take off the Force, ſpread it ſelf, and fill its former Place. So, if you preſs with your Finger a blown Bladder, it will ſpring and riſe again to its Place. And to this may be reduced the Springs of a Watch, and of a Spiral Wire, *&c.*

AGAIN, a ſtiff, but pliable Body, faſtened at one End, and drawn aſide at the other, will ſpring back to its former Place; this is the Caſe of Steel-ſprings of Locks, Snap-haunces, *&c.* and Branches of Trees, when ſhaken with the Wind, or pulled aſide, return to their former Poſture: As is ſaid of the Palm, *Depreſſa Reſurgo.* And there are innumerable inſtances of this kind, where the force is by bending, and the Reſtitution by unbending or returning.

THIS kind is reſembled by a *Pendulum*, or Plummet hanging on a String, whoſe Gravity, like the Spring in thoſe other Bodies, naturally carries it to its place, which here is downward; all heavy Bodies naturally deſcending till they meet with ſome Ob-

Obſtacle to reſt upon. And the loweſt that the Plummet can deſcend in its Reſtraint by the String, is, when it hangs perpendicular, as to *A B*; where it is neareſt to the Horizontal Plane *G H*, and therefore loweſt. Now, if you force the Plummet upward (held at length upon the String) from *B* to *C*, and let it go; it will, by a Spontaneous Motion, endeavour its Reſtitution to *B*: But, having nothing to ſtop it but Air, the Impulſe of its own Velocity will carry it beyond *B*, towards *D*; and ſo backward and forward, decreaſing at every Range, till it come to reſt at *B*.



THUS the *Pendulum* and Spring agree in Nature, if you conſider the Force againſt them, and their Endeavour of Reſtitution.

BUT further, if you take a thin ſtiff *Lamina* of Steel, like a Piece of Two-penny Riband of ſome length, and nail it faſt at one End, (the remainder of it being free in the Air) then force the other End aſide and let it go; it will make Vibrations backward and forward, perfectly anſwering thoſe of a *Pendulum*. And much more, if you contrive it with a little Steel Button at the End of it, both to help the Motion when once ſet on foot, and to bear it better againſt the Reſiſtance of the Air. There will be no difference between the Vibrations of this Spring, and of a *Pendulum*, which in both, will be alike increaſed or decreaſed in Proportion to their Lengths. The ſame End (*viz.* Reſt) being, in the ſame manner, obtained by Gravity in one, and Elaſticity in the other.

FURTHER yet, if you nail the Spring above, and let it hang down perpendicular, with a heavier Weight at the lower End, and then ſet it on moving, the Vibrations will be continued and carried on both by Gravity and Elaſticity, the *Pendulum* and the Spring will be moſt friendly joyned to cauſe a ſimple equal Motion of Librations, I mean, an equal Meaſure of Time in the Recourſes; only the Spring anſwerable to its Strength, may cauſe the

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Librations to be ſome what ſwifter, as an Addition of Tenſion does to a String continued in the ſame length.

I come now to conſider a String of an Inſtrument, which is a Spring faſtned at both Ends. It acquireth a double Elaſticity. The firſt by Tenſion, and the Spring is ſtronger or weaker, according as the Tenſion is greater or leſs. And by how much ſtronger the Spring is, ſo much more frequent are the Vibrations, and by this Tenſion therefore, the Strings of an Inſtrument keeping the ſame length are put in Tune, and this Spring draws length-ways, endeavouring a Relaxation of the Tenſion.

But then, *Secondly*, the String being under a ſtated Tenſion, hath another Elaſtick Power ſide-ways, depending upon the former, by which it endeavours, if it be drawn aſide, to reſtore it ſelf to the eaſieſt Tenſion, in the ſhorteſt, *viz.* ſtreighteſt line.

In the former Caſe, Tenſion doth the ſame with abatement of length, and affects the String properly as a Spring, in that the String being forcibly ſtretched, as forcibly draws back to regain the remiſs Poſture in which it was before: And bears little

little Analogy with the *Pendulum*, except in general, in their ſpontaneous Motions in order to their Reſtitution.

BUT there is great Correſpondence in the ſecond Caſe, between the Librations of a *Pendulum* and the Vibrations of a String (for ſo, for diſtinctions ſake, I will now call them) in that they are both proportioned to their length, as has been ſhewn; and between the Elaſticity which moves the String, and Gravity which moves the *Pendulum*, both of them having the ſame Tendency to Reſtitution, and by the ſame Method. As the Declivity of the Motion of a *Pendulum*, and conſequently the Impulſe of its Gravity is ſtill leſſened in the Arch of its Range from a Semi-Circle, till it come to reſt perpendicular; the Deſcent thereof being more downright at the firſt and greateſt Ranges, and more Horizontal at the laſt and ſhorteſt Ranges, as may be ſeen in the preceding Figure *C I IE E B*; ſo the Impulſe of Spring is ſtill gradually leſſened as the Ranges ſhorten, and as it gains of relaxation, till it come to be reſtored to reſt in its ſhorteſt Line. And this may be the Cauſe of the Equality of Time of the Librations of a *Pendulum*, and alſo of the Vibrations of a String. Now, the Proportions of Length, to the Velo-

Velocity of Vibrations in one, and of Librations in the other, we are ſure of, and find by manifeſt Experience to be quadruple in one, and duple in the other.

Now tack two equal *Pendulums* together (as before) being faſtned at both Ends, take away the Plumbets, and you make it a String, retaining till the ſame Properties of Motion, only what was ſaid before to be cauſed by Gravity, muſt now be ſaid to be done by Elaſticity. You ſee what an eaſie Step here is out of one into the other, and what Agreement there is between them. The *Phænomena* are the ſame, but difficultly experimented in a String, where the Vibrations are too ſwift to fall under each exact Meaſure; but moſt eaſie in a *Pendulum*, whoſe ſlow Librations may be meaſured at pleaſure, and numbered by diſtant Moments of Time.

To bring it nearer, make your Tenſion of the String by Gravity, inſtead of ſcrewing it up with a Pegg or Pin: Hang weight upon a Pulley at one End of the String, and as you increaſe the Weight, ſo you do increaſe the Tenſion, and as you increaſe the Tenſion, ſo you increaſe the Velocity of Vibrations. So the Vibrations are proportionably regulated immediately by Tenſion

ſion, and mediately by Gravity. So that Gravity may claim a ſhare in the Meaſures of theſe Harmonick Motions.

BUT to come ſtill nearer, and home to our purpoſe. Faſten a Gut or Wire-ſtring above, and hang a heavy Weight on it below, as the Weight is more or leſs, ſo will be the Tenſion, and conſequently the Vibrations. But let the ſame Weight continue, and the String will have a ſtated ſetled Tenſion. Here you have both in one, a *Pendulum*, and the Spring of a String, which reſembles a double *Pendulum*: Draw the Weight aſide, and let it range, and it is properly a *Pendulum*, librating after the Nature of a *Pendulum*. Again, when the Weight is at reſt, ſtrike the String with a gentle *Plectrum* made of a Quill, on the upper part, ſo as not to make the Weight move, and the String will vibrate, and give its Tune, like other Strings faſtened at both Ends, as this is alſo, in this Caſe. So you have here both a *Pendulum* and a String, or either, which you pleaſe. And (the Tenſion being ſuppoſed to be ſettled under the ſame Weight) the common Meaſure and Regulator of the Proportions of them is the Length, and as you alter the Length, ſo proportionably you alter at once the Velocity in the Recourſes of the Vibra-

brations of the String, and of the Librations of the *Pendulum*. And though the Vibrations be ſo much ſwifter, and more frequent than the Librations, yet the Rations are altered alike. If you ſubduple the Length of the String, then the Vibrations will be dupled. And if you ſubquadruple it, then the Librations will be alſo dupled, allowing for ſo much of the Body of the Weight as muſt be taken in, to determine the Length of the *Pendulum*.

THE Vibrations are altered in duple Proportion to the Librations, becauſe (as has been ſhewn) the String is as a double *Pendulum*, either one of which ſuppoſed *Pendulums* is but half ſo long as the String, and is quadrupled by dupling the whole String. Still therefore the Proportion of their Alterations holds ſo certainly and regularly with the Proportion of every Change of their common Length, that, if you have the Comparative Ration of either of theſe two, *viz.* Vibrations or Librations to the Length, you have them both: The increaſe of the Velocity of Librations being ſubduple to the increaſe of the Velocity of Vibrations. And thus the Motions of a *Pendulum* do fully and properly diſcover to us, the Motions of a String, by the manifeſt Correſpondence of their

their Properties and Nature. The *Pendulum's* Motion of Gravity, and the Strings of Elaſticity bearing ſo certain Proportions according to Length, that the Principles of Harmony, may be very properly made out, and moſt eaſily comprehended, as explained by the *Pendulum*. And we find, that in all Ages, this part of Harmony was never ſo cheerfully underſtood, as ſince the late Diſcoveries about the *Pendulum*.

And I chuſe to make this Illuſtration by the *Pendulum*, becauſe it is ſo eaſie for Experiment, and for our Comprehenſion; and the Elaſtick Power ſo difficult.

Having ſeen the Origine of Tuneable or Harmonick Sounds, and of their Difference in reſpect of Acuteneſs and Gravity: It is next to be conſidered, how they come to be affected with Conſonancy and Diſſonancy, and what theſe are.

CHAP.

CHAP. III.

Of Conſonancy *and* Diſſonancy.

CONſonancy and Diſſonancy are the Reſult of the Agreement, mixture or uniting (or the contrary) of the undulated Motions of the Air or *Medium*, cauſed by the Vibrations by which the Sounds of diſtinct Tunes are made. And thoſe are more or leſs capable of ſuch Mixture or Coincidence according to the Proportion of the Meaſures of Velocity in which they are made, *i. e.* according as they are more or leſs commenſurate. This I might well ſet down as a *Poſtulatum*. But I ſhall by ſeveral Inſtances endeavour to illuſtrate the undulating Motions or Undulations of the Air; and confirm what is ſaid of their Agreements and Diſagreements. And firſt the Undulations, by ſomewhat we ſee in other Liquids.

LET a Stone drop into the Middle of a ſmall Pond of ſtanding Water when it is quiet, you ſhall ſee a Motion forthwith impreſſed upon the Water, paſſing and dilating from that Center where the Stone fell, in circular Waves one within an other,

ſtill propagated from the Center, ſpreading till they reach and daſh againſt the Banks, and then returning, if the force of the Motion be ſufficient, and meeting thoſe inner Circles which purſue the ſame Courſe, without giving them any Check.

And if you drop a Stone in another place, from that Centre will likewiſe ſpread round Waves; which meeting the other, will quickly paſs them, each moving forwards in its own proper Figure.

The like is better experimented in Quick-ſilver, which being a more denſe Body, continues its Motions longer, and may be placed nearer your Eye. If you try it in a pretty large round Veſſel, ſuppoſe of a Foot Diameter, the Waves will keep their own Motion forward and backward, and quietly paſs by one another as they meet. Something of this may be ſeen in a long narrow Paſſage, where there is not room to advance in Circles.

Make a wooden Trough or long Box, ſuppoſe of two Inches broad, and two deep, and twenty long. Fill in three Quarters or half full of quick-ſilver, and place it Horizontally, when it is at quiet, give it with your Finger a little patt at one End, and

and it will impreſs a Motion of a ridged Wave a croſs, which will paſs on to the other End, and daſhing againſt it, return in the ſame Manner, and daſh againſt the hether End, and go back again, and thus backward and forward, till the Motion ceaſe. Now if after you have ſet this Motion on foot, you cauſe ſuch another, you ſhall ſee each Wave keep its regular Courſe; and when they meet one another, paſs on without any Reluctancy.

I do not ſay theſe Experiments are full to my purpoſe, becauſe theſe being upon ſingle Bodies, are not ſufficient to expreſs the Diſagreements of Diſproportionate Motions cauſed by different Vibrations of different ſounding Bodies; but theſe may ſerve to illuſtrate thoſe inviſible Undulations of Air. And how a Voice reflected by the Walls of a Room, or by Eccho being of adequate Vibrations, returns from the Wall, and meets the commenſurate Undulations paſſing forwards, without hindering one another.

But there are Inſtances which further confirm the Reaſons of Conſonancy and Diſſonancy, by the manifeſt agreeing or diſagreeing Meaſures of Motions already ſpoken of.

It hath been a common Practice to imitate a Tabour and Pipe upon an Organ. Sound together two diſcording Keys (the baſe Keys will ſhew it beſt, becauſe their Vibrations are ſlower) let them, for Example, be Gamut with Gamut ſharp, or F Faut ſharp, or all three together. Though theſe of themſelves ſhould be exceeding ſmooth and well voyced Pipes; yet, when ſtruck together, there will be ſuch a Battel in the Air between their diſproportioned Motions, ſuch a Clatter and Thumping, that it will be like the beating of a Drum, while a Jigg is played to it with the other hand. If you ceaſe this, and ſound a full Cloſe of Concords, it will appear ſurprizingly ſmooth and ſweet, which ſhews how Diſcords well placed, ſet off Concords in Compoſition. But I bring this Inſtance to ſhew, how ſtrong and vehement theſe undulating Motions are, and how they correſpond with the Vibrations by which they are made.

It may be worth the while, to relate an Experiment upon which I happened. Being in an Arched ſounding Room near a ſhrill Bell of a Houſe Clock, when the Alarm ſtruck, I whiſtled to it, which I did with eaſe in the ſame Tune with the Bell, but, endeavouring to whiſtle a Note higher

higher or lower, the Sound of the Bell and its croſs Motions were ſo predominant, that my Breath and Lips were check'd ſo, that I could not whiſtle at all, nor make any Sound of it in that diſcording Tune. After, I ſounded a ſhrill whiſtling Pipe, which was out of Tune to the Bell, and their Motions ſo claſhed, that they ſeemed to ſound like ſwitching one another in the Air.

GALILEO, from this Doctrine of *Pendulums*, eaſily and naturally explains the ſo much admired ſympathy of Conſonant ſtrings; one (though untouch'd) moving when the other is ſtruck. It is perceptible in Strings of the ſame, or another Inſtrument, by trembling ſo as to ſhake off a Straw laid upon the other String: But in the ſame Inſtrument, it may be made very viſible, as in a Baſs-Viol. Strike one of the lower Strings with the Bow, hard and ſtrong, and if any of the other Strings be Uniſon or Octave to it, you ſhall plainly ſee it vibrate, and continue to do ſo, as long as you continue the Stroke of your Bow, and, all the while, the other Strings which are diſſonant, reſt quiet.

THE Reaſon hereof is this. When you ſtrike your String, the Progreſſive ſound

of it ſtrikes and ſtarts all the other Strings, and every of them makes a Movement in its own proper Vibration. The Conſonant ſtring, keeping meaſure in its Vibrations with thoſe of the ſounding String hath its Motion continued, and propagated by continual agreeing Pulſes or Stokes of the other. Whereas the Remainder of the Diſſonant ſtrings having no help, but being checked by the Croſs Motions of the ſounding String, are conſtrained to remain ſtill and quiet. Like as, if you ſtand before a *Pendulum*, and blow gently upon it as it paſſeth from you, and ſo again in its next Courſes keeping exact time with it, it is moſt eaſily continued in its Motion. But if you blow irregularly in Meaſures different from the Meaſure of the Motion of the *Pendulum*, and ſo moſt frequently blow againſt it, the Motion of it will be ſo checked, that it muſt quickly ceaſe.

And here we may take Notice, (as has been hinted before) that this alſo confirms the aforeſaid Equality of the Time of Vibrations to the laſt, for that the ſmall and weak Vibrations of the ſympathizing String are regulated and continued by the Pulſes of the greater and ſtronger Vibrations of the ſounding String, which proves, that not-

notwithſtanding that Diſparity of Range, they are commenſurate in the Time of their Motion.

THIS Experiment is ancient: I find it in *Ariſtides Quintilianus* a *Greek* Author, who is ſuppoſed to have been contemporary with *Plutarch*. But the Reaſon of it deduced from the *Pendulum*, is new, and firſt diſcovered by *Galileo*.

IT is an ordinary Trial, to find out the Tune of a Beer-glaſs without ſtriking it, by holding it near your Mouth, and humming loud to it, in ſeveral ſingle Tunes, and when you at laſt hitt upon the Tune of the Glaſs, it will tremble and Eccho to you. Which ſhews the Conſent and Uniformity of Vibrations of the ſame Tune, though in ſeveral Bodies.

TO cloſe this Chapter. I may conclude that Conſonancy is the Paſſage of ſeveral Tuneable ſounds through the *Medium*, frequently mixing and uniting in their undulated Motions, cauſed by the well proportioned commenſurate Vibrations of the ſonorous Bodies, and conſequently arriving ſmooth, and ſweet, and pleaſant to the Ear. On the contrary, Diſſonancy is from diſproportionate Motions of Sounds, not mix-

ing, but jarring and claſhing as they paſs, and arriving to the Ear Harſh, and Grating, and Offenſive. And this, in the next Chapter ſhall be more amply explained.

Now, what Concords and Diſcords are thus produced, and in uſe, in order to Harmony, I ſhall next conſider.

CHAP. IV.

Of Concords.

CConcords are Harmonick ſounds, which being joined pleaſe and delight the Ear; and Diſcords the Contrary. So that it is indeed the judgment of the Ear that determines which are Concords and which are Diſcords. And to that we muſt firſt reſort to find out their Number. And then we may after ſearch and examine how the natural Production of thoſe Sounds, diſpoſeth them to be pleaſing or unpleaſant. Like as the Palate is abſolute Judge of Taſts, what is ſweet, and what is bitter, or ſowr, *&c.* though there may be alſo found out ſome natural Cauſes of thoſe Qualities. But the Ear being entertained with Motions which fall under exact De-

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monſtrations of their Meaſures, the Doctrine hereof is capable of being more accurately diſcovered.

First then, (ſetting aſide the Uniſon Concord, which is no Space nor Interval, but an Indentity of Tune) the Ear allows and approves theſe following Intervals, and only theſe for Concords to any given Note, *viz.* the Octave or Eighth, the Fifth, then the Fourth, (though by later Maſters of Muſick degraded from his Place) then the Third *Major*, the Third *Minor*, the Sixth *Major*, and the Sixth *Minor*. And alſo ſuch, as in the Compaſs of any Voice or Inſtrument beyond the Octave, may be compounded of theſe, for ſuch thoſe are, I mean compounded, and only the former ſeven are ſimple Concords; not but that they may ſeem to be compounded, *viz.* the greater of the leſs within an Octave, and therefore may be called Syſtems, but they are Originals. Whereas beyond an Octave, all is but Repetition of theſe in Compound with the Eighth, as a Tenth is an Eighth and a Third; a Twelfth is an Eighth and a Fifth; a Fifteenth is Diſdiapaſon, *i. e.* two Octaves, *&c.*

But notwithſtanding this Diſtinction of Original and Compound Concords; and tho'

tho' theſe Compounded Concords are found, and diſcerned by their Habitude to the Original Concords comprehended in the Syſtem of Diapaſon; (as a Tenth aſcending is an Octave above the Third, or a Third above the Octave; a Twelfth is an Octave to the Fifth, or a Fifth to the Eighth, a Fifteenth is an Eighth above the Octave, *i. e.* Diſdiapaſon two Eighths, *&c.)* yet they muſt be own'd, and are to be eſteem'd good and true Concords, and equally uſeful in Melody, eſpecially in that of Conſort.

The Syſtem of an Eighth, containing ſeven Intervals, or Spaces, or Degrees, and eight Notes reckoned incluſively, as expreſſed by eight Chords, is called Diapaſon, *i. e.* a Syſtem of all intermediate Concords, which were anciently reputed to be only the Fifth and the Fourth, and it comprehends them both, as being compounded of them both: And now, that the Thirds and Sixths are admitted for Concords, the Eighth contains them alſo: *Viz.* a Third *Major* and Sixth *Minor*, and again a Third *Minor* and Sixth *Major*. The Octave being but a Replication of the Uniſon, or given Note below it, and the ſame, as it were in Miniature, it cloſeth and terminates the firſt perfect Syſtem, and

and the next Octave above it aſcends by the ſame Intervals, and is in like manner compounded of them, and ſo on, as far as you can proceed upwards or downwards with Voices or Inſtruments, as may be ſeen in an Organ, or Harpſichord. It is therefore moſt juſtly judged by the Ear, to be the chief of all Concords, and is the only Conſonant Syſtem, which being added to it ſelf, ſtill makes Concords.

And to it all other Concords agree, and are Conſonant, though they do not all agree to each other; nor any of them make a Concord if added to it ſelf, and the Complement or Reſidue of any Concord to Diapaſon, is alſo Concord.

The next in Dignity is the Fifth, then the Fourth, Third *Major*, Third *Minor*, Sixth *Major*, and laſtly Sixth *Minor*; all taken by Aſcent from the Uniſon or given Note.

By Uniſon is meant, ſometimes the Habitude or Ration of Equality of two Notes compared together, being of the very ſame Tune. Sometimes (as here) for the given ſingle Note to which the Diſtance, or the Rations of other Intervals are compared. As, if we conſider the Relations to *Gamut*,

to

to which *A re* is a Tone or Second, *B mi* a Third, *C* a Fourth, *D* a Fifth, *&c.* We call *Gamut* the Uniſon, for want of a more proper Word. Thus *C faut*, or any other Note to which other Intervals are taken, may be called the Uniſon.

And the Reader may eaſily diſcern, in which Senſe it is taken all along by the Coherence of the Diſcourſe.

I come now to conſider the natural Reaſons, why Concords pleaſe the Ear, by examining the Motions by which all Concords are made, which having been generally alledged in the beginning of the third Chapter, ſhall now more particularly be diſcuſſed.

And here I hope the Reader will pardon ſome Repetition in a Subject that ſtands in need of all Light that may be, if, for his eaſe and more ſteady Progreſs, before I proceed, I call him back to a Review and brief Summary of ſome of thoſe Notions, which have been premis'd and conſidered more at large. I have ſhewed,

1. That Harmonick Sound or Tune is made by equal Vibrations or Tremblings of a Body fitly conſtituted.

2. That

2. THAT thoſe Vibrations make their Courſes and Recourſes in the ſame Meaſure of Time; from the greateſt Range to the leſſer, till they come to reſt.

3. THAT thoſe Vibrations are under a certain Meaſure of Frequency of Courſes and Recourſes in a given Space of Time.

4. THAT if the Vibrations be more frequent, the Tune will be proportionably more Acute; if leſs frequent, more Grave.

5. THAT the Librations of a *Pendulum* become doubly frequent, if the *Pendulum* be made four times ſhorter; and twice ſlower, if the *Pendulum* be four times longer.

6. THAT a Chord, or String of a Muſical Inſtrument, is as a double *Pendulum*, or two *Pendulums* tacked together at length, and therefore hath the ſame Effects by dupling; as a *Pendulum* by quadrupling, *i. e.* by dupling the Length of the Chord, the Vibrations will be ſubdupled, *i. e.* be half ſo many in a given Time. And by ſubdupling the length of the Chord, the Vibrations will be dupled, and proportionably ſo in all other Meaſures of Length, the Vibrations bearing a Reciprocal proportion to the Length.

7. THAT

7. THAT theſe Vibrations impreſs a Motion of Undulation or Trembling in the *Medium* (as far as the Motion extends) of the ſame Meaſure with the Vibrations.

8. THAT if the Motions made by different Chords be ſo commenſurate, that they mix and unite; bear the ſame Courſe either altogether, or alternately, or frequently: Then the Sounds of thoſe different Chords, thus mixing, will calmly paſs the *Medium*, and arrive at the Ear as one Sound, or near the ſame, and ſo will ſmoothly and evenly ſtrike the Ear with Pleaſure, and this is Conſonancy, and from the want of ſuch Mixture is Diſſonancy. I may add, that as the more frequent Mixture or Coinſidence of Vibrations, render the Concords generally ſo much the more perfect: So, the leſs there is of Mixture, the greater and more harſh will be the Diſcord.

FROM the Premiſes, it will be eaſie to comprehend the natural Reaſon, why the Ear is delighted with thoſe forenamed Concords; and that is, becauſe they all unite in their Motions often, and at the leaſt at every ſixth Courſe of Vibration, which appears from the Rations by which they are conſtituted, which are all contained

ed within that Number, and all Rations contained within that Space of Six, make Concords, becauſe the Mixture of their Motions is anſwerable to the Ration of them, and are made at or before every Sixth Courſe. This will appear if we examine their Motions. Firſt, how and why the Uniſons agree ſo perfectly; and then finding the Reaſon of an Octave, and fixing that, all the reſt will follow.

To this purpoſe, ſtrike a Chord of a ſounding Inſtrument, and at the ſame Time, another Chord ſuppoſed to be in all reſpects Equal, *i. e.* in Length, Matter, Thickneſs and Tenſion. Here then, both the Strings give their Sound; each Sound is a certain Tune; each Tune is made by a certain Meaſure of Vibrations; the ſame Vibrations are impreſſed upon, and carried every way along the *Medium*, in Undulations of the ſame Meaſure with them, until the Sounds arrive at the Ear. Now the Chords being ſuppoſed to be equal in all reſpects; it follows, that their Vibrations muſt be alſo equal, and conſequently move in the ſame Meaſure, joyning and uniting in every Courſe and Recourſe, and keeping ſtill the ſame Equality, and Mixture of Motions of the String, and in the *Medium*. Therefore the Habitude of theſe two Strings

Strings is called Uniſon, and is ſo perfectly Conſonant, that it is an Identity of Tune, there being no Interval or Space between them. And the Ear can hardly judge, whether the Sound be made by two Strings, or by one.

But Conſonancy is more properly conſidered, as an Interval, or Space between Tones of different Acuteneſs or Gravity. And amongſt them, the moſt perfect is that which comes neareſt to Uniſon, (I do not mean betwixt which there is the leaſt Difference of Interval; but, in whoſe Motions there is the greateſt Mixture and Agreement next to Uniſon. The Motions of two Uniſons are in Ration of 1 to 1, or of Equality. The next Ration in whole Numbers is 2 to 1, Duple. Divide a Monochord in two Equal parts, half the Length compared to the whole, being in Subduple Ration, will make double Vibrations, making two Recourſes in the ſame time that the other makes one, and ſo uniting and mixing alternately, *i. e.* every other Motion. Then comparing the Sounds of theſe two, and the half will be found to ſound an Octave to the whole Chord. Now the Octave (aſcending from the Uniſon) being thus found and fixed to be in duple Proportion of Vibrations, and

and ſubduple of Length; conſequently the Proportions of all other Intervals are eaſily found out.

THEY are found out by reſolving or dividing the Octave into the Mean Rations which are contain'd in it. *Euclid*, in his *Sectio Canonis*, *Theorem* 6, gives two Demonſtrations to prove, that Duple Ration contains, and is compos'd of the two next Rations, *viz.* *Seſquialtera* and *Seſquitertia*. Therefore an Octave which is in Duple Ration 2 to 1 is divided into, and compos'd of a Fifth, whoſe Ration is found to be *Seſquialtera* 3 to 2; and a Fourth, whoſe Ration is *Seſquitertia* 4 to 3. In like manner *Seſquialtera* is compos'd of *Seſquiquarta* and *Seſquiquinta*; that is, a Fifth, 3 to 2, may be divided into a Third *Major*, 5 to 4; and a Third *Minor*, 6 to 5, *&c.*

THERE is an eaſie Way to take a view of the Mean Rations, which may be contain'd in any Ration given, by transferring the Prime or Radical Numbers of the given Ration into greater Numbers of the ſame Ration, as 2 to 1 into 4 to 2, or 6 to 3, *&c.* which have the ſame Ration of Duple. Again, 3 to 2 into 6 to 4, which is ſtill *Seſquialtera*. Now in 4 to 2 the Mediety is 3. So that 4 to 3, and 3 to 2, are compren-

ded in 4 to 2; that is, a Fourth and a Fifth are comprehended in an Eighth. In 6 to 4 the Mediety is 5, so 6 to 4 contains 6 to 5, and 5 to 4; *i. e.* a Fifth contains the two Thirds. Let 6 to 3 be the Octave, and it contains 6 to 5 Third *less*, 5 to 4 Third *major*, and 4 to 3 a Fourth, and hath two Medieties, 5 and 4. Of this I shall say more in the next Chapter.

These Rations express the Difference of Length in several Strings which make the Concords; and consequently the Difference of their Vibrations. Take two Strings A B, in all other respects equal, and compare their Lengths, which, if equal, make Unison, or the same Tune. If A be double in Length to B, *i. e.* 2 to 1, the Vibrations of B will be duple to those of A, and unite alternately, *viz.* at every Course, crossing at the Recourse, and give the Sound of an Octave to A.

If the Length of A be to that of B as 3 to 2, and consequently the Vibrations as 2 to 3, their Sounds will consort in a Fifth, and their Motions unite after every second Recourse, *i. e.* at every other or third Course.

If

If A to B be as 4 to 3, they ſound a Fourth, their Motions uniting after every third Recourſe, *viz.* at every fourth Courſe.

If A to B be as 5 to 4, they ſound a Ditone, or Third *Major*, and unite after every fourth Recourſe, *i. e.* every fifth Courſe.

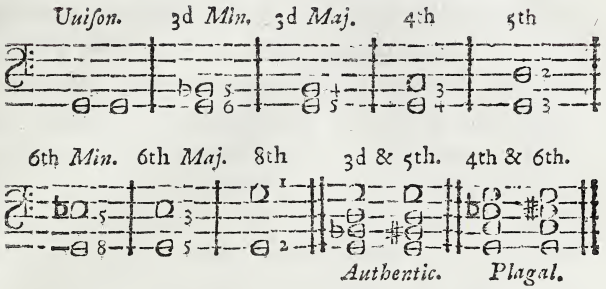
If A to B be as *6* to 5, they ſound a Trihemitone, or Third *Minor*, uniting after every fifth Recourſe, at every ſixth Courſe.

Thus, by the frequency of their being mix'd and united, the Harmony of joyn'd Concords is found ſo very ſweet and pleaſing; the Remoter being alſo combined by their relation to other Concords beſides the Uniſon. The greater Sixth, 5 to 3, is within the compaſs of Rations between 1 and *6*; but, I confeſs, the leſſer Sixth, 8 to 5, is beyond it; but is the Complement of *6* to 5 to an Octave, and makes a better Concord by its Combinations with the Octave, and Fourth from the Uniſon; having the Relation of a Third *Minor* to One, and of a Third *Major* to the Other, and their Motions uniting accordingly. And the Sixth *Major* hath the ſame Advantage. Of theſe Combinations I ſhall

have occaſion to ſay ſomewhat more, after I have made the Subject in hand as plain as I can.

I propos'd the collating of two ſeveral Strings, to expreſs the Conſort which is made by them; but otherwiſe, theſe Rations are more certainly found upon the Meaſures of a Monochord, taken by being apply'd to the Section of a Canon, or a Rule of the String's length divided into Parts, as occaſion requires; becauſe there is no need ſo often to repeat *Cæteris paribus*, as is when ſeveral Strings are collated. And if you take the Rations as Fractions, it will be more eaſie to meaſure out the given Parts of a Monochord, or ſingle String extended on an Inſtrument: Thoſe Parts of the String divided by a moveable Bridge or Fret put under, and made to ſound; That Sound, related to the Sound of the Whole, will give the Interval ſought after. *Ex. gr.* $\frac{1}{2}$ of the Chord gives an Eighth, $\frac{2}{3}$ give a Fifth, $\frac{3}{4}$ ſound a Fourth, $\frac{4}{5}$ ſound a Third *Major*, $\frac{5}{6}$ a Third *Minor*, $\frac{3}{5}$ a Sixth *Major*, $\frac{5}{8}$ a Sixth *Minor*: Now we thus expreſs theſe Concords.

Uniſon.



I ſaid, that all Concords are in Rations within the Number Six; and I may add, that all Rations within the Number Six are Concords: Of which take the following Scheme.

6 to 5 3d *Minor.*	4 to 3 4th	6 to 5 3d *Minor.*
to 4 5th	to 2 8th	5 to 4 3 d *Major.*
to 3 8th	to 1 15th	4 to 3 Fourth
to 2 12th		3 to 2 Fifth
to 1 19th	3 to 2 5th	2 to 1 Eighth
	to 1 12th	
5 to 4 3d *Major.*	2 to 1 8th	
to 3 6th *Major.*		
to 2 10th *Major.*		
to 1 17th *Major.*		

All that are Concords to the Uniſon, are alſo Concords to the Octave And all that are Diſcords to the Uniſon, are Diſ-

cords to the Octave. And some of the Intermediate Concords, are Concords one to another; as, the two Thirds to the Fifth, and the Fourth to the two Sixths. So that the Unison, Third, Fifth, and Octave; or the Unison, Fourth, Sixth, and Octave, may be founded together to make a compleat Close of Harmony: I do not mean a Close to conclude with, for the Plagal is not such; but a compleat Close, as it includes all Concords within the compass of *Diapason*. A Scheme of which I have set down at the end of the 'foregoing Staff of five Lines, which containeth the Notes by which the aforesaid Concords are express'd. The former two, which ascend from the Unison, *Gamut*, by Third *Major* (or *Minor*) and Fifth, up to the Octave, are usually call'd Authentick, as relating principally to the Unison, and best satisfying the Ear to rest upon: The other two, which ascend by the Fourth and Sixth *Minor* (or *Major*) up to the same Octave, are call'd *Plagal*, as more combining with the Octave, seeming to require a more proper Bass Note, *viz.* an Eighth below the Fourth, and therefore not making a good concluding Close: And on the continual shifting these, or often changing them, depends the Variety of Harmony (as far as Consonancy reacheth, which is but as the Body of Musick) in all

all Contrapunct chiefly, but indeed in all kinds of Compoſition. I do not exclude a Sprinkling of Diſcords, nor here meddle with Air, Meaſure, and Rythmus, which are the Soul and Spirit of Muſick, and give it ſo great a commanding Power. The Plagal Moods deſcend by the ſame Intervals, by which the Authentick aſcend; which is by Thirds and Fifths; and the Authentick deſcend the ſame by which the Plagal aſcend, *viz.* by Fourths and Sixths; one chiefly relating to the Uniſon, the other to the Octave.

But that, for which I deſcrib'd theſe full Cloſes, was chiefly to give (as I promis'd) a larger account of the beforemention'd Combinations of Concords, which encreaſe the Conſonancies of each Note, and make a wonderful Variegation and Delightfulneſs of the Harmony.

Cast your Eye upon the firſt of them in the Authentick Scale, you will ſee that *Bmi* hath three Relations of Conſonancy, *viz.* to the Uniſon, or given Note G; to the Fifth, and to the Octave: To the Uniſon as a Third *minor*; to the Fifth as a Third *major*; to the Octave a Sixth *major*; ſo that its Motions joyn after every fifth Recourſe, *i. e.* at every ſixth Courſe,

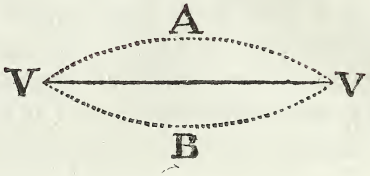
with the Uniſon ; every fifth with the Diapente or Fifth ; every ſixth Courſe with the Octave. Then conſider the Diapente, *D ſol re* ; as a Fifth to the Uniſon, it joyns with it every third Courſe ; and as a Fourth to the Octave, they joyn every fourth Courſe. Then, the Octave with the Uniſon, joyns after every ſecond Vibration, *i. e.* at every Courſe.

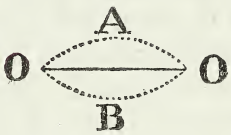
Now take a Review of the Variety of Conſonancies in theſe four Notes. Here are mix'd together in one Conſort the Rations of 2 to 1, 3 to 2, 4 to 3, 5 to 4, 6 to 5, 5 to 3. And juſt ſo it is in the other Cloſes, only changing alternately the Sixths.

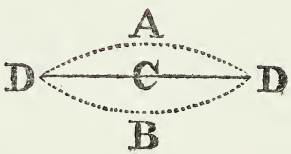
You may ſee here, within the ſpace of three Intervals from the Uniſon, *viz.* 3d, 5th, and 8th, what a Concourſe there is of Conſonant Rations, to variegate and give (as 'twere) a pleaſant Purling to the Harmony within that Space : For now, all this Variety is form'd within one Syſtem of *Diapaſon*, juſtly bearing that Name. But then, think what it will be when the remote Compounded Concords are joyn'd to them ; as when we make a full Cloſe with both Hands upon an Organ, or Harpſichord, or when the higher Part of a Conſort of Muſick is reconcil'd to the lower, by the middle

middle Parts, *viz.* the Treble to the Baſs, by the Mean and Tenor: And all this, refreſh'd by the Interchangings made between the Plagal and Authentick Moods. Add to all this the infinite Variety of Movement of ſome Parts, thro' all Spaces, while ſome Part moves ſlowly; and (as in *Fuges*) one Part chaſing and purſuing another.

THE whole Reaſon of Conſonancy being founded upon the Mixture and Uniting of the Vibrating Motions of ſeveral Chords, or ſounding Bodies, 'tis fit it ſhould here be better explain'd and confirm'd. That their Mixtures accord to their Rations, 'tis eaſie to be computed; but it may be repreſented to your Eye.







V	A	B	B	A	A	B	B	A	A	B, &c.
O	AB	BA	AB	BA	AB	BA	AB	BA	AB	BA.

V	AB	BA	AB	BA	AB, &c.
D	ABC	CAB	BAC	CBA	ABC.

LET

Let V V be a Chord, and ſtand for the Uniſon: Let O O be a Chord half ſo long, which will be an Octave to the Uniſon, and the Vibrations double: Then, I ſay, they will alternately (*i. e.* at every other Vibration) unite. Let from A to B be the Courſe of the Vibration, and from B to A the Recourſe; obſerving by the way, that (in relation to the Figures mention'd in this Paragraph and the next, as alſo in the former Diagram of the *Pendulum*, cap. 2, pag. 9.) when I ſay, [from B to A] and [overtakes V in A, *&c.*] I do there endeavour to expreſs the Matter brief and perſpicuous, without perplexing the Figures with many Lines; and avoiding the Incumbrance of ſo many Cautions, whereby to diſtract the Reader: Yet I muſt always be underſtood to acknowledge the continual Decreaſe of the Range of Vibrations between A and B, while the Motion continues; and by A and B mean only the Extremities of the Range of all thoſe Vibrations, both the Firſt greateſt, and alſo the Succeſſive leſſen'd, and gradually contracted Extremities of their Range. And the following Demonſtration proceeds and holds equally in both, being apply'd to the Velocity of Recourſes, and not to the Compaſs of their Range, which is not at all here conſider'd. Such a kind of Equity, I muſt

muſt ſometimes, in other parts of this Diſcourſe, beg of the candid Reader. To proceed therefore, I ſay, whilſt V being ſtruck, makes his Courſe from A to B; O (ſtruck likewiſe) will have his Courſe from A to B, and Recourſe from B to A. Next, whilſt V makes Recourſe from B to A, O is making its Courſe contrary, from A to B, but recourſeth, and overtakes V in A, and then they are united in A, and begin their Courſe together. So you ſee, that the Vibrations of *Diapaſon* unite alternately, joyning at every Courſe of the Uniſon, and croſſing at the Recourſe.

THUS alſo *Diapente*, or Fifth, having the Ration of 3 to 2, unites in like manner at every third Courſe of the Uniſon. Let the Chord D D be Diapente to the Uniſon V; whilſt V courſeth from A to B, the Chord D courſeth from A to B, and makes half his Recourſe as far as C; *i. e.* 3 to 2. Whilſt V recourſeth from B to A, D paſſeth from C to A, and back from A to B. Whilſt V courſeth again from A to B, D paſſeth from B to A, and back to C. Whilſt V recourſeth from B to A, D paſſeth from C to B, and back to A; and then they unite in A, beginning their Courſes together at every third Courſe of V. In like manner the reſt of the Concords unite, at the

the 4th, 5th, 6th Courſe, according to their Rations, as might this ſame way be ſhewn, but it would take up too much room, and is needleſs, being made evident enough from theſe Examples already given.

THUS far the Rates and Meaſures of *Conſonance* lead us on, and give us the true and demonſtrable Grounds of Harmony: But ſtill 'tis not compleat without Diſcords and Degrees (of which I ſhall treat in another Chapter) intermix'd with the Concords, to give them a Foyl, and ſet them off the better. For (to uſe a homely Reſemblance) that our Food, taken alone, tho' proper, and wholſome, and natural, may not cloy the Palate, and abate the Appetite, the Cook finds ſuch kinds and varieties of Sawce, as quicken and pleaſe the Palate, and ſharpen the Appetite, tho' not feed the Stomach; as Vinegar, Muſtard, Pepper, *&c.* which nouriſh not, nor are taken alone, but carry down the Nouriſhment with better Reliſh, and aſſiſt it in Digeſtion. So the Practical Maſters and Skilful Compoſers make uſe of Diſcords, judiciouſly taken, to reliſh the Conſort, and make the Concords arrive much ſweeter at the Ear, in all ſorts of Deſcant, but moſt frequently in Cadence to a Cloſe. In all which, the chief Regard is to be had

to

to what the Ear may expect in the Conduct of the Compoſition, and muſt be perform'd with Moderation and Judgment; which I now only mention, not intending to treat of Compoſing, which is out of my Deſign and Sphere, and would be too large; but my Deſign is, to make theſe Grounds as plain as I can, thereby to gratifie thoſe whoſe Philoſophical Learning, without previous Skill in Muſick, will eaſily render them capable of this Theory: And alſo thoſe Maſters in Practick Muſick, and Lovers of it, who, tho' wanting Philoſophy, and the Latin and other Foreign Tongues, to read better Authors; yet, by the help of their Knowledge in Muſick, may attain to underſtand the depth of the Grounds and Reaſons of Harmony, for whoſe ſakes it is done in this Language.

I ſhall conclude this Chapter with ſome Remarks, concerning the Names given to the ſeveral Concords: We call them *Third*, *Fourth*, *Fifth*, *Sixth*, and *Eighth*. Of theſe the *Third*s being Two, and *Sixths* being alſo Two, want better diſtinguiſhing Names. To call them Flat and Sharp Thirds, and Flat and Sharp Sixths, is not enough, and lies under a Miſtake; I mean, it is not a ſufficient Diſtinction, to call the greater

Third

Third and Sixth, Sharp Third and Sharp Sixth, and the leſſer, Flat. They are ſo indeed in aſcending from the Uniſon, but in deſcending they are contrary; for to the Octave that greater Sixth is a leſſer Third, and the greater Third is a leſſer Sixth; which leſſer Third and Sixth cannot well be call'd Flat, being in a Sharp Key; Flat and Sharp therefore do not well diſtinguiſh them in general; the leſſer Third from the Octave being ſharp, and the greater Sixth flat. So, from the Fifth deſcending by Thirds, if the firſt be a *minor* Third, it is ſharp, and the other being a *major* Third, cannot be ſaid to be flat.

The other Diſtinction of them, *viz.* by *Major* and *Minor*, is more proper, and does well expreſs which of them we mean. But ſtill the common and confuſed Name of *Third*, if the Diſtinction of *major* and *minor* be not always well remember'd, is apt to draw young Practitioners, who do not well conſider, into another Error. I would therefore call the greater Third (as the *Greeks* do) *Ditone*, *i. e.* of two whole Tones; and the Third *minor*, *Trihemitone* or *Seſquitone*, as conſiſting of three half-Tones, (or rather of a Tone and half a Tone) and this would avoid the mention'd Error which I am going to deſcribe.

It

It is a Rule in compoſing Conſort Muſick, that it is not lawful to make a Movement of two Uniſons, or two Eighths, or two Fifths together; nor of two Fourths, unleſs made good by the addition of Thirds in another Part: But we may move as many Thirds or Sixths together as we pleaſe. Which laſt is falſe, if we keep to the ſame ſort of Thirds and Sixths; for the two Thirds differ one from another in like manner as the Fourth differs from the Fifth: For in the ſame manner as the Eighth is divided into a Fifth and Fourth, ſo is a Fifth into a *Third major* and *Third minor*. Now call them by their right Names, and, I ſay, it is not lawful to make a Movement of as many *Ditones*, or of as many *Seſquitones* as you pleaſe: And therefore when you take the Liberty ſpoken of, under the general Names of *Thirds*, it will be found that you mix *Ditones* and *Tribemitones*, and ſo are not concern'd in the aforeſaid Rule; and ſo the Movements of *Sixths* will be made with mixture and interchanges of 6th *major* and 6th *minor*, which is ſafe enough.

Yet, I confeſs, there is a little more Liberty in moving *Tribemitones* and *Ditones*, as likewiſe either of the Sixths, than there is in moving Fourths or Fifths; and the

the Ear will bear it better. Nay, there is neceſſity, in a gradual Movement of Thirds, to make one Movement by two *Trihemitones* together in every Fourth and Fifth, or Fourth disjunct; that is, twice in *Diapaſon*, or, at leaſt, in two Fifths; as in *Gamut* Key proper. The natural Aſcent will be *Ut Re Mi Fa Sol La:* Now, to theſe join Thirds in Natural Aſcent, and then they will be *Mi Fa Sol La Fa Sol.* $\left\{\begin{matrix} Mi\ Fa\ Sol\ La\ Fa\ Sol \\ Ut\ Re\ Mi\ Fa\ Sol\ La \end{matrix}\right\}$ And thus it will be in other Cliffs, but with ſome variation, according to the Place of the *Hemitone*. Here $\left\{\begin{matrix} Fa \\ Re \end{matrix}\right\}$ and $\left\{\begin{matrix} Sol \\ Mi \end{matrix}\right\}$ are two *Trihemitones* ſucceeding one another, and you cannot well alter them without diſordering the Aſcent, and diſturbing the Harmony; becauſe, where there is a *Hemitone*, the Tone below join'd to it, makes a *Trihemitone*; and the next Tone above it, join'd to it, makes the ſame. Thus you ſee the neceſſity of moving two *Trihemitones* together, twice in *Diapaſon*, or a 9th, in progreſſion of Thirds, in *Diatonic* Harmony, but you cannot well go further.

Now, there is Reaſon why two *Trihemitones* will better bear it, becauſe of their different Relations, by which one *Trihemi-*

tone is better diſtinguiſh'd from another, than one Octave, or one Fifth, or one Fourth from another.

In a Third *minor*, which hath two Degrees or Intervals, conſiſting of a Tone and *Hemitone*, the *Hemitone* may be placed either in the lower Space, and then generally is united to his Third *major* (which makes the Complement of it to a Fifth) downward, and makes a ſharp Key; or elſe it may be placed in the upper Space, and then generally takes his third *major* above, to make up the fifth upward, and conſtitute a flat Key. And thus a *Tritone* is avoided both ways. I ſay, if the *Hemitone* in the Third *minor* be below, then the Third *major* lies below it, and the Air is ſharp. If the *Hemitone* be above, then the Third *major* lies above, and the Air is flat. And thus the two *minor* Thirds join'd in conſequence of Movement, are differenc'd in their Relations, conſequent to the place of the *Hemitone*; which Variety takes off all Nauſeouſneſs from the Movement, and renders it ſweet and pleaſant.

You cannot ſo well and regularly make a Movement of *Ditones*, tho' it may be done ſometimes, once or twice, or more,

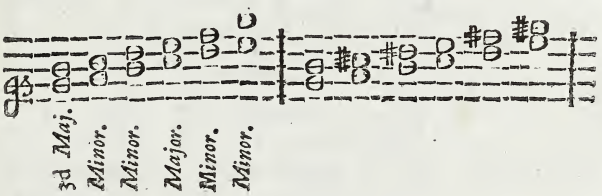
in

in a Bearing Paſſage (in like manner as you may ſometimes uſe Diſcords) to give, after a little grating, a better Reliſh. The Skilful Artiſt may go farther in the uſe of Thirds and Diſcords than is ordinarily allow'd.

I might enlarge this Chapter, by ſetting down Examples of the Lawful and Unlawful Movements of *Thirds major* and *minor*, and of the Uſe of *Diſcords*; but, as I ſaid before, my Deſign is not to treat of Compoſition: However, you may caſt your Eye upon theſe following Inſtances, and your own Obſervation from the beſt Maſters will furniſh you with the reſt.

Lawful Movement of Thirds, Mix'd.

Unlawful Movement of Thirds *Major*.



THAT the Reader may not incurr any Miſtake or Confuſion, by ſeveral Names of the ſame Intervals, I have here ſet them down together, with their Rations.

8th	Octave, Diapaſon.		2 to	1
9th *Major.*	Hsptachord *Major.*		15	8
7th *Minor.*	Heptachord *Minor.*		9	5
6th *Major.*	Hexachord *Major.*		5	3
6th *Minor.*	Hexachord *Minor.*		8	5
5th	Diapente, Pentachord.		3	2
5th *Falſe* (in defect)	Semidiapente.		64	45
4th *Falſe* (in exceſs)	Tritone.		45	32
4th	Diateſſaron, Tetrachord.		4	3
3d *Major*	Ditone.		5	4
3d *Minor*	Seſquitone. / Trihemitone. / Semiditone.		6	5
2d *Maj.* or Whole Note *Major*	Tone *Major*	Degrees Diatonic. *Max.*	9	8
2d *Min.* or Whole Note *Minor*	Tone *Minor*	*Min.*	10	9
2d *Leaſt*, or Half-Note *Greater*	Hemi-tone *Maj* / Semi-	*Minim.*	16	15
Half-Note *Leſs*	Hemi-tone *Minor.* / Semi- / Dieſis Chromatic. / Dieſis *Major.*		25	24
Quarter-Note	Dieſis Enharmonic. / Dieſis *Minor.*		128	125
Difference between Tone *Major*, and Tone *Minor.*	Comma, Comma *Majus.* / Schiſm.		81	80

Note, Whenever I mention Dieſis without diſtinction, I mean Dieſis *Minor*, or Enharmonic: And when I ſo mention Comma, I mean Comma *Majus*, or Schiſm.

I ſhould next treat of *Diſcords*, but becauſe there will intervene ſo much Uſe of *Calculation*, it is needful that (before I go further) I premiſe ſome account of Proportion in General, and apply it to Harmony.

CHAP. V.

Of Proportion; and apply'd to Harmony.

WHEREAS it hath been ſaid before, That Harmonick Bodies and Motions fall under Numerical Calculations, and the Rations of Concords have been already aſſign'd; it may ſeem neceſſary here (before we proceed to ſpeak of Diſcords) to ſhew the Manner how to calculate the Proportions appertaining to Harmonick Sounds: And for this I ſhall better prepare the Reader, by premiſing ſomething concerning Proportion in General.

We may compare (*i. e.* amongſt themſelves) either (1.) *Magnitudes*, (ſo they be of the ſame kind;) or (2.) the *Gravitations*, *Motions*, *Velocities*, *Duration*, *Sounds*, &c. from thence ariſing; or fur-

ther, if you pleaſe, the Numbers themſelves, by which the Things compar'd are explicated. And if theſe ſhall be unequal, we may then conſider, either, *Firſt*, how much one of them exceeds the other; or, *Secondly*, after what manner one of them ſtands related to the other, as to the Quotient of the Antecedent (or former Term) divided by the Conſequent (or latter Term:) Which Quotient doth expound, denominate, or ſhew, how many times, or how much of a time or times, one of them doth contain the other. And this by the *Greeks* is call'd λόγος, *Ratio*; as they are wont to call the *Similitude*, or *Equality* of Ratio's ἀναλογία, *Analogie*, *Proportion*, or *Proportionality*: But Cuſtom, and the Senſe aſſiſting, will render any over-curious Application of theſe Terms unneceſſary.

From theſe two Conſiderations laſt mention'd there are wont to be deduced three ſorts of Proportion, *Arithmetical*, *Geometrical*, and a mix'd Proportion reſulting from theſe two, call'd *Harmonical*.

1. *Arithmetical*, when three or more Numbers in Progreſſion have the ſame Difference; as, 2, 4, 6, 8, &c. or diſcontinued, as 2, 4, 6; 14, 16, 18.

2. *Geo-*

2. *Geometrical*, when three or more Numbers have the ſame Ration, as 2, 4, 8, 16, 32; or diſcontinued, 2, 4; 64, 128.

Laſtly, *Harmonical*, (partaking of both the other) when three Numbers are ſo order'd that there be the ſame Ration of the Greateſt to the Leaſt, as there is of the Difference of the two Greater to the Difference of the two Leſs Numbers: As in theſe three Terms, 3, 4, 6, the Ration of 6 to 3 (being the greateſt and leaſt Terms) is Duple. So is 2, the Difference of 6 and 4 (the two greater Numbers) to 1, the Difference of 4 and 3 (the two leſs Numbers) Duple alſo. This is Proportion Harmonical, which Diapaſon, 6 to 3, bears to Diapente 6 to 4, and Diateſſaron 4 to 3, as its mean Proportionals.

Now for the Kinds of Rations moſt properly ſo call'd, *i. e. Geometrical*: Firſt obſerve, that in all Rations the former Term or Number (whether greater or leſs) is always call'd the *Antecedent*, and the other following Number is call'd the *Conſequent*. If therefore the Antecedent be the greater Term, then the Ration is either *Multiplex*, *Superparticular*, *Superpartient*, or (what is compounded of theſe) *Multi-*

plex Superparticular, or *Multiplex Superpartient.*

1. *Multiplex*; as Duple, 4 to 2; Triple, 6 to 2; Quadruple, 8 to 2.

2. *Superparticular*; as, 3 to 2, 4 to 3, 5 to 4, exceeding but by one aliquot part, and in their Radical or leaſt Numbers, always but by one; and theſe Rations are term'd *Seſquialtera*, *Seſquitertia* (or *Supertertia*) *Seſquiquarta*, (or *Superquarta*) &c. *Note*, that Numbers exceeding more than by one, and but by one aliquot part, may yet be *Superparticular*, if they be not expreſs'd in their Radical, *i. e.* leaſt Numbers; as 12 to 8 hath the ſame Ration as 3 to 2; *i. e. Superparticular*, tho' it ſeem not ſo till it be reduced by the greateſt Common Diviſor to its Radical Numbers 3 to 2. And the Common Diviſor (*i. e.* the Number by which both the Terms may ſeverally be divided) is often the Difference between the two Numbers; as in 12 to 8, the Difference is 4, which is the Common Diviſor. Divide 12 by 4, the Quotient is 3; divide 8 by 4, the Quotient is 2; ſo the Radical is 3 to 2. Thus alſo 15 to 10 divided by the Difference 5, gives 3 to 2; yet, in 16 to 10, 2 is the Common Diviſor, and gives 8 to 5, being *Superpartient.*

tient. But in all *Superparticular* Rations, whoſe Terms are thus made larger by being multiply'd, the Difference between the Terms is always the greateſt Common Diviſor; as in the 'foregoing Examples.

THE third kind of Ration is *Superpartient*, exceeding by more than One, as 5 to 3, which is call'd *Superbipartiens Tertias* (or *Tria*) containing 3 and $\frac{2}{3}$; 8 to 5, *Supertripartiens Quintas*, 5 aud $\frac{3}{5}$.

THE fourth is *Multiplex Superparticular*, as 9 to 4, which is duple, and *Seſquiquarta*, 13 to 4, which is triple, and *Seſquiquarta*.

THE fifth and laſt is *Multiplex Superpartient*, as 11 to 4; duple, and *Supertripartiens Quartas*.

WHEN the Antecedent is leſs than the Conſequent, *viz.* when a leſs is compar'd to a greater, then the ſame Terms ſerve to expreſs the Rations, only prefixing *Sub* to them; as, *Submultiplex*, *Subſuperparticular* (or *Subparticular*) *Subſuperpartient* (or *Subpartient*) &c. 4 to 2 is *Duple*, 2 to 4 is *Subduple*. 4 to 3 is *Seſquitertia*; 3 to 4 is *Subſeſquitertia*; 5 to 3 is *Superbipartiens Tertias*; 3 to 5 is *Subſuperbipartiens Tertias*, &c.

THIS

THIS ſhort Account of Proportion was neceſſary, becauſe almoſt all the Philoſophy of Harmony conſiſts in Rations, of the Bodies, of the Motions, and of the Intervals of Sound, by which Harmony is made.

AND in ſearching, ſtating, and comparing the Rations of theſe, there is found ſo much Variety, and Certainty, and Facility of Calculation, that the Contemplation of them may ſeem not much leſs delightful than the very Hearing the good Muſick it ſelf, which ſprings from this Fountain. And thoſe who have already an affection for Muſick cannot but find it improv'd and much enhaunc'd by this pleaſant recreating Chace (as I may call it) in the large Field of *Harmonic Rations* and *Proportions*, where they will find, to their great Pleaſure and Satisfaction, the hidden Cauſes of Harmony (hidden to moſt, even to Practitioners themſelves) ſo amply diſcover'd and laid plain before them.

ALL the Habitudes of Rations to each other are found by Multiplication or Diviſion of their Terms; by which any Ration is added to, or ſubſtracted from another: And there may be uſe of Progreſſion of Ra-

Rations, or Proportions, and of finding a *Medium* or *Mediety* between the Terms of any Ration: But the main Work is done by Addition and Subſtraction of Rations; which, tho' they are not perform'd like Addition and Subſtraction of Simple Numbers in Arithmetick, but upon Algebraick Grounds, yet the Praxis is moſt eaſie.

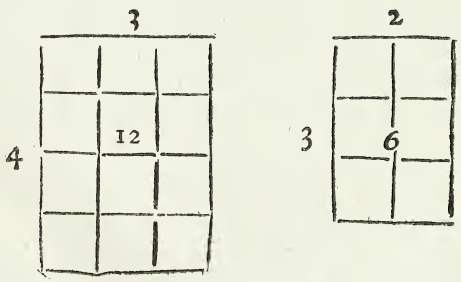
ONE Ration is added to another Ration, by multiplying the two antecedent Terms together; *i. e.* the Antecedent of one of the Rations by the Antecedent of the other (for the more eaſe they ſhould be reduced into their leaſt Numbers or Terms) and then the two Conſequent Terms in like manner. The Ration of the Product of the Antecedents, to that of the Product of the Conſequents, is equal to the other two added or join'd together. Thus (for Example) add the Ration of 8 to *6*; *i. e.* (in Radical Numbers) 4 to 3, to the Ration of 12 to 10; *i. e.* *6* to 5, the Product will be 24 and 15; *i. e.* 8 to 5. You may ſet 'em thus, and multiply 4 by *6*, they make 24, which ſet at the bottom; then multiply 3 by 5, they make 15, which likewiſe ſet under, and you have 24 to 15; which is a Ration compounded

4	3
6	5
24.	15

of

of the other two, and equal to them both. Reduce theſe Products, 24 and 15, to their leaſt Radical Numbers, which is, by dividing as far as you can find a common Diviſor to them both (which is here done by 3) and that brings them to the Ration of 8 to 5. By this you ſee, that a *Third minor*, 6 to 5, added to a Fourth, 4 to 3, makes a *Sixth minor*, 8 to 5. If more Rations are to be added, ſet them all under each other, and multiply the firſt Antecedent by the ſecond, and that Product by the third, and again that Product by the Fourth, and ſo on; and ſo in like manner the Conſequents.

THIS Operation depends upon the Fifth Propoſition of the Eighth Book of *Euclid*; where he ſhews, that the Ration of Plain Numbers is compounded of their Sides. See theſe Diagrams:



Now

Now compound these Sides. Take for the Antecedents, 4 the greater Side of the greater Plane, and 3 the greater Side of the less Plane, and they multiply'd give 12: Then take the remaining two Numbers 3 and 2, being the less Sides of the Planes (for Consequents) and they give 6. So the Sides of 4 and 3, and of 3 and 2, compounded (by multiplying the Antecedent Terms by themselves, and the Consequents by themselves) make 12 to 6, *i. e.* 2 to 1; which being apply'd, amounts to this; *Ratio Sesquialtera*, 3 to 2, added to *Ratio Sesquitertia* 4 to 3, makes Duple Ration, 2 to 1. Therefore *Diapente* added to *Diatessaron*, makes *Diapason*.

Substraction of one Ration from another greater is perform'd in like manner by multiplying the Terms; but this is done not *Laterally*, as in Addition, but *Crosswise*; by multiplying the Antecedent of the former (*i. e.* of the greater) by the Consequent of the latter, which produceth a new Antecedent; and the Consequent of the former by the Antecedent of the latter, which gives a new Consequent. And therefore it is usually done by an Oblique Decussation of the Lines. For Example, If you would take 6 to 5 out of 4 to 3,

you

you may ſet them down as in the Margin; Then 4 multiply'd by 5, makes 20, and 3 by 6 gives 18: So 20 to 18, *i. e.* 10 to 9, is the Remainder. That is, ſubſtract a Third *Minor* out of a Fourth, and there will remain a Tone *Minor*.

4 3
X
6 5
20.18.
10. 9.

MULTIPLICATION of Rations is the ſame with their Addition, only 'tis not wont to be of divers Rations, but of the ſame, being taken twice, thrice, or oftener, as you pleaſe. And as before in Addition you added divers Rations by multiplying them, ſo here in Multiplication you add the ſame Ration to it ſelf, after the ſame manner, *viz.* by multiplying the Terms of the ſame Ration by themſelves; *i. e.* the Antecedent by it ſelf, and the Conſequent by it ſelf, (which in other Words is to multiply the ſame by 2) and will, in the Operation, be to ſquare the Ration firſt propounded (or give the Second Ordinal Power, the Ration firſt given being the Firſt Power or Side.) And to this Product, if the Simple Ration ſhall again be added (after the ſame manner as before) the Aggregate will be triple of the Ration firſt given; or the Product of that Ration multiply'd by 3, *viz.* the Cube, or Third Ordinal Power. Its *Biquadrate*, or Fourth

Fourth Power, proceeds from multiplying it by 4, and ſo ſucceſſively in order as far as you pleaſe you may advance the Powers. For inſtance, the Duple Ration, 2 to 1, being added to it ſelf, dupled, or multiply'd by 2, produceth 4 to 1, (the Ration *Quadruple*) : And if to this, the firſt again be added, which is equivalent to multiplying that ſaid firſt by 3) there will ariſe the Ration *Octuple*, or 8 to 1. Whence the Ration 2 to 1 being taken for a Root, its Duple 4 to 1 will be the Square, its Triple 8 to 1 the Cube thereof, *&c.* as hath been ſaid above. And, to uſe another Inſtance, To duple the Ration of 3 to 2, it muſt be thus ſquar'd ; 3 by 3 gives 9 : 2 by 2 gives 4 ; ſo the Duple or Square of 3 to 2 is 9 to 4. Again, 9 by 3 is 27, and 4 by 2 is 8, ſo the Cubic Ration of 3 to 2 is 27 to 8. Again, to find the Fourth Power, or *Biquadrate*, (*i. e.* ſquar'd Square) 27 by 3 is 81, 8 by 2 is 16 ; ſo 81 to 16 is the Ration of 3 to 2 quadrupled, as 'tis dupled by the Square, tripled by the Cube, *&c.* To apply this Inſtance to our preſent purpoſe, 3 to 2 is the Ration of *Diapente*, or a Fifth in Harmony ; 9 to 4 is the Ration of twice *Diapente*, or a Ninth (viz. *Diapaſon* with *Tone Major*) ; 27 to 8 is the Ration of thrice *Diapente*, or three Fifths, which is *Diapaſon* with Six *Major* (*viz.* 13th *Major*)

The

The Ration of 81 to 16 makes four Fifths, i. e. *Diſ-diapaſon*, with two *Tones Major*, *i. e.* a Seventeenth *Major*, and a Comma of 81 to 80.

To divide any Ration, you muſt take the contrary Way, and by extracting of theſe Roots reſpectively, Diviſion by their *Indices* will be perform'd. *E. gr.* To divide it by 2, is to take the Square Root of it; by 3, the Cubic Root; by 4, the Biquadratick, *&c.* Thus to divide 9 to 4 by 2, the Square Root of 9 is 3, the Square Root of 4 is 2; then 3 to 2 is a Ration juſt half ſo much as 9 to 4.

From hence it will be obvious to any to make this Inference; That Addition and Multiplication of Rations are (in this caſe) one and the ſame thing. And theſe Hints will be ſufficient to ſuch as bend their Thoughts to theſe kinds of Speculations, and no great Treſpaſs upon thoſe that do not.

The Advantage of proceeding by the Ordinal Powers, Square, Cube, *&c.* (as is before mention'd) may be very uſeful where there is Occaſion of large Progreſſions; as, to find (for Example) how many Comma's are contain'd in a *Tone Major*, or other Interval.

Interval; let it be, How many are in *Diapaſon?* Which muſt be done by multiplying Comma's, *i. e.* adding them, till you arrive at a Ration equal to *Octave*, (if that be ſought) *viz.* Duple: Or elſe by dividing the Ration of *Diapaſon* by that of a Comma, and finding the Quotient; which may be done by Logarithms. And herein I meet with ſome Differences of Calculations.

MERSENNUS finds, by his Calculation, $58\frac{1}{4}$ Comma's, and ſomewhat more, in an *Octave*: But the late *Nicholas Mercator*, a Modeſt Perſon, and a Learned and Judicious Mathematician, in a Manuſcript of his, of which I have had a Sight, makes this Remark upon it; *In ſolvendo hoc Problemate aberrat Merſennus:* And he, working by the Logarithms, finds out but 55, and a little more; and from thence has deduced an ingenious Invention of finding and applying a leaſt Common Meaſure to all Harmonic Intervals, not preciſely perfect, but very near it.

SUPPOSING a Comma to be $\frac{1}{53}$ part of Diapaſon; for better Accommodation rather than according to the true Partition $\frac{1}{55}$, which $\frac{1}{53}$ he calls an Artificial Comma, not exact, but differing from the true Natural

tural Comma about $\frac{1}{10}$ part of a Comma, and $\frac{1}{1000}$ of Diapaſon (which is a Difference imperceptible) then the Intervals within Diapaſon will be meaſur'd by Comma's according to the following Table; which you may prove by adding two, or three, or more of theſe Numbers of Comma's, to ſee how they agree to conſtitute thoſe Intervals, which they ought to make; and the like by ſubſtracting.

Intervals	$\frac{\circ}{54}$	Intervals	$\frac{\circ}{53}$
Comma	1	4th	22
Dieſis	2	*Tritone*	26
Semit. Minus	3	*Semidiapente*	27
Semit. Medium	4	5th	31
Semit. Majus	5	6th *Minor*	36
Semit. Maximus	6	6th *Major*	39
Tone Minor	8	7th *Minor*	45
Tone Major	9	7th *Major*	48
3d *Minor*	14	*Octave*	53
3d *Major*	17		

THIS I thought fit, on this Occaſion, to impart to the Reader, having Leave ſo to do from Mr. *Mercator*'s Friend, to whom he preſented the ſaid Manuſcript.

HERE I may advertiſe the Reader, that it is indifferent whether you compare the greater

greater Term of an Harmonic Ration to the leſs, or the leſs to the greater; *i. e.* whether of them you place as Antecedent, *e. gr.* 3 to 2, or 2 to 3; becauſe in Harmonies the Proportions of Lengths of Chords, and of their Vibrations, are reciprocal or counter-chang'd: As the Length is encreas'd, ſo the Vibrations are in the ſame proportion decreas'd; *& é contra.* If therefore (as in *Diapente)* the length of the Uniſon String be 3, then the length (*cæteris paribus*) of the String which in aſcent makes *Diapente* to that Uniſon muſt be 2, or $\frac{2ds}{3}$: Thus the Ration of *Diapente* is 2 to 3 in reſpect of the Length of it, compar'd to the Length of the Uniſon String.

AGAIN, the String 2 vibrates thrice in the ſame Time that the String 3 vibrates twice; and thus the Ration of *Diapente*, in reſpect of Vibrations, is 3 to 2: So that where you find in Authors ſometimes the greater Number in the Rations ſet before and made the Antecedent, ſometimes ſet after and made the Conſequent, you muſt underſtand in the former, the Ration of their Vibrations; and in the latter, the Ration of their Lengths; which comes all to one.

Or, you may underſtand the Uniſon to be compar'd to *Diapente* above it, and the Ration of Lengths is 3 to 2, of Vibrations 2 to 3, or elſe *Diapente* to be compar'd to the Uniſon, and then the Ration of Lengths is 2 to 3, of Vibrations 3 to 2. This is true in ſingle Rations, or if one Ration be compar'd to another; then the two greater Terms muſt be rank'd as Antecedents; or otherwiſe, the two leſſer Terms.

The Difference between Arithmetical and Geometrical Proportion is to be well heeded. An Arithmetical mean Proportion is that which has equal Difference to the Antecedent and Conſequent Terms of thoſe Numbers to which it is the Mediety, and is found by adding the Terms, and taking half the Sum. Thus between 9 and 1, which added together make 10, the Mediety is 5; being Equidifferent from 9 and from 1; which Difference is 4: As 5 exceeds 1 by 4; ſo likewiſe 9 exceeds 5 by 4. And thus in Arithmetical Progreſſion 2, 4, 6, 8; where the Difference is only conſider'd, there is the ſame Arithmetical Proportion between 2 and 4, 4 and 6, 6 and 8; and between 2 and 6, and 4 and 8: But in Geometrical Proportion, where is conſider'd not the Numerical Difference, but another Habitude of the Terms, *viz.* how many times,

times, or how much of a time or times, one of them doth contain the other (as hath been explain'd at large in the beginning of this Chapter.) There the Mean Proportional is not the ſame with Arithmetical, but found another way; and equidifferent Progreſſions make different Rations. The Rations (taking them all in their leaſt Terms) expreſs'd by leſs Numbers, being greater than thoſe of greater Numbers, I mean in Proportions *ſuper particular*, &c. where the Antecedents are greater than the Conſequents, (as, on the contrary, where the Antecedents are leſs than the Conſequents, the *Ratio's* of leſs Numbers are leſs than the *Ratio's* of greater.) The Mediety of 9 to 1 is not now 5, but 3; 3 having the ſame Ration to 1 as 9 has to 3, (as 9 to 3, ſo 3 to 1) *viz.* triple. And ſo in Progreſſion Arithmetical, of Terms having the ſame Differences; if conſider'd Geometrically, the Terms will all be comprehended by unequal Rations. The Differences of 2 to 4, 4 to 6, 6 to 8, are equal, but the Rations are unequal; 2 to 4 is leſs than 4 to 6, and 4 to 6 leſs than 6 to 8. As on the contrary, 4 to 2 is greater than 6 to 4, and 6 to 4 greater than 8 to 6: For 4 to 2 is duple, 6 to 4 but *Seſquialtera* (one and a half only, or $\frac{1}{2}$) and 8 to 6 is no more than *Seſquitertia*, (one and a third

part, or $\frac{4}{3}$) which shews a considerable inequality of their Rations. In like manner 6 to 2 is triple; 8 to 4 is but duple, and yet their Differences equal. Thus the mean Rations comprehended in any greater Ration divided Arithmetically, *i. e.* by equal Differences, are unequal to one another, consider'd Geometrically. Thus 2, 3, 4, 5, 6, if you consider the Numbers, make an Arithmetical Progression: But if you consider the Rations of those Numbers, as is done in Harmony, then they are unequal, every one being greater or less (according as you proceed by Ascent or Descent) than the next to it. Thus, in this Progression, (understanding, together with the Ratio's, the Intervals themselves, as is before premised) 2 to 3 is the greatest, being *Diapente*; 3 to 4 the next, *Diatessaron*; 4 to 5 still less, *viz. Ditone*; 5 to 6 the least, being *Sesquitone*. Or, if you descend, 6 to 5 least; 5 to 4 next, *&c.* These are the mean Rations comprehended in the Ration of 6 to 2, by which *Diapason cum Diapente*, or a 12th, is divided into the aforesaid Intervals, and measured by them, *viz.* as is 6 to 2, (*viz.* triple) so is the Aggregate of all the mean Rations within that Number, 6 to 5, 5 to 4, 4 to 3, and 3 to 2: Or 6 to 5, 5 to 2; or 6 to 4, 4 to 2; or 6 to 3, 3 to 2. The Aggregates of these are equal to 6 to 2, *viz.* triple.

THIS is premiſed in order to proceed to what was intimated in the 'foregoing Chapter.

TAKING notice firſt of this Procedure, peculiar to Harmonics, *viz.* to make Progreſſion or Diviſion in Arithmetical Proportion in reſpect of the Numbers; but to conſider the things number'd according to their Rations Geometrical. And thus Harmonic Proportion is ſaid to be compounded of Arithmetical and Geometrical.

YOU may find them all in the Diviſion of the Syſtem of *Diapaſon* into *Diapente* and *Diateſſaron*, i. e. 5th and 4th, aſcending from the Uniſon.

IF by *Diapente* firſt, then by 2, 3, 4, Arithmetically. If firſt by *Diateſſaron*, then by 3, 4, 6, Harmonically. And theſe Rations conſider'd Geometrically, in relation to Sound, there is likewiſe found Geometrical Proportions between the Numbers 6, 3 to 4, 2; and 6, 4 to 3, 2.

THE Ancients therefore owning only 8th, 5th, and 4th, for ſimple Conſonant Intervals, concluded them all within the Numbers of 12, 9, 8, 6, which contain'd them

all: *viz.* 12 to 6, *Diapaſon*; 12 to 8, *Diapente*; 12 to 9, *Diateſſaron*; 9 to 8, *Tone*. And which ſerv'd to expreſs the three kinds of Proportion, *viz.* Harmonical, between 12 to 8, and 8 to 6; Arithmetical, between 12 to 9, and 9 to 6; and Geometrical, between 12 to 9 and 8 to 6; and between 12 to 8, and 9 to 6. It was ſaid therefore, that *Mercurius*'s Lyre was ſtrung with four Chords, having thoſe Proportions, 6, 8, 9, 12. *Gaſſend.*

I intimated, that I would here more largely explain that ready and eaſie Way of finding and meaſuring the mean Rations contain'd in any of thoſe Harmonic Rations given, by transferring them out of their Prime or Radical Numbers into greater Numbers of the ſame Ration. By dupling (not the Ration, but the Terms of it; ſtill continuing the ſame Ration) you will have one Mediety; as, 2 to 1 dupled is 4 to 2; and you have 3 the Mediety. By tripling you will have two Means; 2 to 1 tripled is 6 to 3, containing 3 Rations; 6 to 5, 5 to 4, 4 to 3; and ſo ſtill more, the more you multiply it.

Now obſerve, firſt, that any Ration *Multiplex* or *Superpartient* (or by tranſferring it out of its Radical Numbers made like

like *Superpartient*) contains ſo many *Superparticular* Rations, as there are Units in the Difference between the Antecedent and the Conſequent. Thus in 8 to 4 (being 2 to 1 transferr'd by quadrupling) the Difference is 4, and it contains 4 *Superparticular* Rations, *viz.* 8 to 7, 7 to 6, 6 to 5, and 5 to 4; where tho' the Progreſſion of Numbers is Arithmetical, yet the Proportions of Exceſs are Geometrical and Unequal. The *Superparticular* Rations expreſs'd by leſs Numbers being greater (as hath been ſaid) than thoſe that conſiſt of greater Numbers; 5 to 4 is a greater Ration than 6 to 5, and 6 to 5 greater than 7 to 6, and 7 to 6 than 8 to 7; as a Fourth part is greater than a Fifth, and a Fifth greater than a Sixth, *&c.* But in this Inſtance there are two Rations not appertaining to Harmonics, *viz.* 8 to 7, and 7 to 6.

Secondly therefore, you may make unequal Steps, and take none but Harmonic Rations, by ſelecting greater and fewer intermediate Rations, tho' ſome of them compos'd of ſeveral *Superparticulars*; provided you do not diſcontinue the Rational Progreſſion, but that you repeat ſtill the laſt Conſequent, making it the next Antecedent; as if you meaſure the Ration of

8 to 4

8 to 4, by 8 to *6* and *6* to 4, or by 8 to 5 and 5 to 4, or by 8 to *6*, and *6* to 5, and 5 to 4; in theſe three ways the Rations are all Harmonical, and are reſpectively contain'd in, and make up the Ration of 8 to 4. Thus you may meaſure, and divide, and compound moſt harmonic Rations without your Pen.

To that End I would have my Reader to be very perfect in the Radical Numbers which expreſs the Rations of the ſeven firſt (or uncompounded) Conſonants, *viz. Diapaſon*, 2 to 1; *Diapente*, 3 to 2; *Diateſſaron*, 4 to 3; *Ditone*, 5 to 4; *Trihemitone*, 6 to 5; *Hexachordon Majus*, 5 to 3; *Hexachordon Minus*, 8 to 5; and likewiſe of the Degrees in Diatonick Harmony, *viz. Tone Major*, 9 to 8; *Tone Minor*, 10 to 9; *Hemitone Major*, 16 to 15; and the Differences of thoſe Degrees; *Hemitone Greateſt*, 27 to 25; and *Hemitone Minor*, 25 to 24; *Comma*, or *Schiſm*, 81 to 80; *Dieſis Enharmonic*, 128 to 125.

Of other *Hemitones* I ſhall treat in the Eighth Chapter.

Now if you would divide any of the Conſonants into two Parts, you may do it by the Mean or Mediety of the two Radical

cal Numbers, if they have a Mean; and where they have not, (as when their *Ratio's* are *Superparticular)* you need but duple thoſe Numbers, and you will have a Mean (one or more.) Thus duple the Numbers of the Ration of *Diapaſon*, 2 to 1, and you have 4 to 2; and then 3 is the Mean by which it is divided into two unequal, but proper and harmonical parts, *viz.* 4 to 3, and 3 to 2. After this manner *Diapaſon*, 4 to 2, comprehends 4 to 3, and 3 to 2: So *Diapente*, 6 to 4, is 6 to 5, and 5 to 4: *Ditone*, 10 to 8, is 10 to 9, and 9 to 8; ſo Sixth *major*, 5 to 3, is 5 to 4, and 4 to 3.

THO', from what was now obſerv'd, you may divide any of the Conſonants into intermediate Parts, yet when you divide theſe three following, *viz.* Sixth *minor*, *Diateſſaron*, and *Trihemitone*, you will find that thoſe Parts into which they are divided, are not all ſuch Intervals as are harmonical. The Sixth *minor*, whoſe Ration is 8 to 5, contains in it three Means, *viz.* 8 to 7, 7 to 6, and 6 to 5; the laſt whereof only is one of the harmonick Intervals, of which the Sixth *minor* conſiſts, *viz. Trihemitone*; and to make up the other Interval, *viz. Diateſſaron*, you muſt take the other two, 8 to 7, and 7 to 6; which being

ing added (or, which is the ſame thing, taking the *Ratio* of their two Extream Terms, *that* being the Sum of all the intermediate ones added) you have 8 to 6, or (in the leaſt Terms) 4 to 3. Again, *Diateſſaron*, in Radical Numbers 4 to 3; being (if thoſe Numbers are dupled) 8 to 6, gives for his Parts 8 to 7, and 7 to 6; which *Ratio's* agree with no Intervals that are Harmonick; therefore you muſt take the Ration of *Diateſſaron* in other Terms, which may afford ſuch Harmonick Parts. And to do this, you muſt proceed farther than dupling (or adding it once to it ſelf) for to this Duple you muſt add the firſt Radical Numbers once again (which in effect is the ſame with tripling it at firſt) *viz.* 4 and 3, to 8 and 6; and the Aggregate will be a new, but equivalent, Ration of *Diateſſaron*; viz. 12 to 9. And this gives you three Means, 12 to 11, and 11 to 10; both Unharmonical; but which together are, as was ſhew'd before, the ſame with 12 to 10 (or 6 to 5) *Tribemitone*; and 10 to 9 *Tone minor*; and are the two Harmonical Intervals of which *Diateſſaron* conſiſts, and which divide it into the two neareſt equal Harmonick Parts. Laſtly, *Tribemitone*, or Third *minor*, 6 to 5; or (thoſe Numbers being dupled) 12 to 10, gives 12 to 11, and 11 to 10, which are Un-

Unharmonical Rations; but tripled (after the former manner) 6 to 5 gives 18 to 15, which divides it ſelf (as before) into 18 to 16, *Tone major*; and 16 to 15, *Hemitone major*.

Thus, by a little Practice, all Harmonick Intervals will be moſt eaſily meaſur'd, by the leſſer Intervals compriz'd in them. Now, for Exerciſe ſake, take the Meaſures of a greater Ration: Suppoſe that of 16 to 3 be given as an Harmonick Syſtem. To find what it is, and of what Parts it conſiſts; firſt find the groſs Parts, and then the more minute. You will preſently judge, that 16 to 8 (being a Part of this Ration) is *Diapaſon*; and 8 to 4 is likewiſe *Diapaſon*: Then 16 to 4 is *Diſdiapaſon*, or a Fifteenth, and the remaining 4 to 3 is a Fourth. So then 16 to 3 is *Diſdiapaſon* and *Diateſſaron*; *i. e.* an Eighteenth; 16 to 8, 8 to 4, and 4 to 3.

But, to find all the Harmonick Intervals within that Ration (for we now consider Rations as relating to Harmony) take this Scheme.

16 to 3 contains.

In Radicals.

16 to 15,		*Hemitone.*
15 to 12,	5 to 4,	*Ditone.*
12 to 10,	6 to 5,	*Trihemitone.*
10 to 9,		*Tone Minor.*
9 to 8,		*Tone Major.*
8 to 6,	4 to 3,	*Diateſſaron.*
6 to 5,		*Trihemitone.*
5 to 4,		*Ditone.*
4 to 3,		*Diateſſaron.*
Tot. 16 to 3	*Diſdiapaſon cum Diateſſaron.*	

Or thus,

In Radicals.

16 to 10,	8 to 5,	6th *Minor.*
10 to 6,	5 to 3,	6th *Major.*
6 to 4,	3 to 2,	5th
4 to 3,		4th
Tot. 16 to 3		*Eighteenth.*

ALL

ALL theſe Intervals thus put together are comprehended in, and make up, the Ration of 16 to 3, being taken in a conjunct Series of Rations.

BUT otherwiſe, within this compaſs of Numbers are contain'd many more Expreſſions of Harmonick Ration. *Ex. gr.*

	Radicals.		*Radicals.*
16 to 15,		12 to 6,	2 to 1.
16 to 12,	4 to 3.	12 to 4,	3 to 1.
16 to 10,	8 to 5.	12 to 3,	4 to 1.
16 to 8,	2 to 1.	10 to 9,	
16 to 6,	8 to 3.	10 to 8,	5 to 4.
16 to 4,	4 to 1.	10 to 6,	5 to 3.
16 to 3.		10 to 5,	2 to 1.
15 to 12,	5 to 4.	9 to 8,	
15 to 10,	3 to 2.	9 to 6,	3 to 2.
15 to 5,	3 to 1.	9 to 3,	3 to 1.
15 to 3,	5 to 1.	8 to 6,	4 to 3.
14 to 7,	2 to 1.	8 to 5,	
12 to 10,	6 to 5.	8 to 4,	2 to 1.
12 to 9,	4 to 3.	6 to 5, *&c.*	
12 to 8,	3 to 2.	*Vid.* Pag. 67.	

AND now I ſuppoſe the Reader better prepar'd to proceed in the remainder of this Diſcourſe, where we ſhall treat of *Diſcords*.

CHAP.

CHAP. VI.

Of Diſcords and Degrees.

ALL Habitudes of one Chord to another, that are not *Concords*, (ſuch as are before deſcrib'd) are *Diſcords*; which are or may be innumerable, as are the minute Tenſions by which one Chord may be made to vary from it ſelf, or from another. But here we are to conſider only ſuch Diſcords as are uſeful (and in truth neceſſary) to *Harmony*, or at leaſt relating to it, as are the Differences found between *Harmonick Intervals*.

AND theſe apt and uſeful Diſcords are either ſimple uncompounded Intervals, ſuch as immediately follow one another, aſcending or deſcending in the Scale of Muſick; as, *Ut*, *Re*, *Mi*, *Fa*, *Sol*, *La*, *Fa*, *Sol*, and are call'd *Degrees*: Or elſe greater Spaces or Intervals compounded of Degrees including or skipping over ſome of them, as all the *Concords* do, *Ut Mi*, *Ut Fa*, *Ut Sol*, &c. And ſuch are the *Diſcords* of which we now

now treat, as principally the *Tritone*, Falſe Fifth, and the two Sevenths, *Major* and *Minor*, if they be not rather among the Degrees, *&c.* For more Perſpicuity, I ſhall treat of them ſeverally, *viz.* of *Degrees*, of *Diſcords*, and of *Differences*.

And firſt of *Degrees*.

DEGREES are uncompounded Intervals, which are found upon eight Chords, and in ſeven Spaces, by which an immediate Aſcent or Deſcent is made from the *Uniſon* to the *Octave* or *Diapaſon*; and by the ſame Progreſſion to as many *Octaves* as there may be Occaſion. Theſe are different, according to the different Kinds of Muſic, *viz.* *Enharmonic*, *Chromatic*, and *Diatonic*, and the ſeveral Colours of the two latter: (all which I ſhall more conveniently explain by and by); but of theſe now mention'd, the *Diatonic* is the moſt proper and natural Way: The other two, if for Curioſities ſake we conſider them only by running the Notes of an *Octave* up or down in theſe Scales, ſeem rather a Force upon Nature; yet herein probably might lie the Excellency of the ancient *Greeks*: But we now uſe only the *Diatonic* Kind, intermixing here and there ſome of the *Chro-*

matic, (and more rarely ſome of the *Enharmonic:*) And our Excellency ſeems to lie in moſt artificial Compoſing, and joining ſeveral Parts in Symphony or Conſort; which they cannot be ſuppos'd to have effected, at leaſt in ſo many Parts as we ordinarily make, becauſe (as is generally affirm'd of them) they own'd no Concords beſides Eighth, Fifth, and Fourth, and the Compounds of theſe.

F. Kircher (cited alſo by *Gaſſendus* without any Mark of Diſſent) is of Opinion, that the ancient *Greeks* never uſed Conſort Muſic, *i. e.* of different Parts at once, but only Solitary, for one ſingle Voice or Inſtrument; and, that *Guido Aretinus* firſt invented and brought in Muſic of Symphony or Conſort, both for the one and the other. They apply'd Inſtruments to Voice, but how they were managed, he muſt be wiſer than I that can tell.

THIS Way of theirs ſeems to be more proper (by the elaborate Curioſity and Nicety of Contrivance of Degrees, and by Meaſures rather than by harmonious Conſonancy, and by long-ſtudied Performance) to make great Impreſſions upon the Fancy, and operate accordingly, as ſome Hiſtories relate: Ours more ſedately affects the Un-

Underſtanding and Judgment, from the judicious Contrivance and happy Compoſition of Melodious Conſort. The One quietly, but powerfully, affects the Intellect by true Harmony; the Other, chiefly by the *Rythmus*, violently attacks and hurries the Imagination. In fine, upon the natural Grounds of Harmony (of which I have hitherto been treating) is founded the *Diatonic* Muſic; but not ſo, or not ſo regularly, the *Chromatic* or *Enharmonic* Kinds. Take this following View of them.

THE Ancients aſcended from the *Uniſon* to an *Octave* by two Syſtemes of Tetrachords or Fourths. Theſe were either Conjunct, when they began the Second Tetrachord at the Fourth Chord, *viz.* with the laſt Note of the firſt Tetrachord, and which being ſo join'd, conſtituted but a Seventh; and therefore they aſſumed a *Tone* beneath the *Uniſon* (which they therefore call'd *Proſlambanomenos)* to make a full Eighth.

OR elſe the two Tetrachords were diſjunct, the Second taking its beginning at the Fifth Chord, there being always a *Tone Major* between the Fourth and Fifth Chords. So the Degrees were immediately apply'd

to the Fourths, and by them to the *Octave*; and were different according to the different Kinds of Muſic. In the common *Diatonic Genus* the Degrees were *Tone* and *Semitone*; Intervals more Equal and Eaſy, and Natural. In the common *Chromatic*, where the Degrees were *Hemitones* and *Trihemitones*, the Difference of ſome of the Intervals was greater: But the greateſt Difference, and conſequently difficulty, was in the *Enharmonic* Kind, uſing only *Dieſis*, or quarter of a *Tone*, and *Ditone*, as the Degrees whereby they made the Tetrachord.

And to conſtitute theſe Degrees, ſome of them, *viz.* the Followers of *Ariſtoxenus*, divided a *Tone Major* into Twelve equal Parts, *i. e.* ſuppoſed it ſo divided: Six of which being the *Hemitone*, (*viz.* half of it) made a Degree of *Chromatic Toniæum*; and Three of them, or a quarter, call'd *Dieſis*, a Degree *Enharmonic*. The *Chromatic* Fourth roſe thus, *viz.* from the firſt Chord to the ſecond was a *Hemitone*; from the ſecond to the third, a *Hemitone*; from the Third to the Fourth, a *Trihemitone*; or as much as would make up a juſt Fourth. And this laſt Space (in this caſe) was accounted as well as either of the other, but one Degree or undivided Interval. And they

they call'd them *Spiſs Intervals* [πυκνὰ] when two of thoſe other Degrees put together, made not ſo great an Interval as one of theſe; as, in the *Enharmonie* Tetrachord, two *Dieſes* were leſs than the remaining *Ditone*, and in the common *Chromatic*, two *Hemitone* Degrees were leſs than the remaining *Trihemitone* Degree.

THEN for the *Enharmonic* Fourth, the firſt Degree was a *Dieſis*, or quarter of a *Tone*; the ſecond alſo Three of thoſe Twelve Parts, *viz.* a *Dieſis*; the third a *Ditone*, ſuch as made up a juſt Fourth. And this *Ditone* (tho' ſo large a Degree) being conſider'd as thus placed (in the *Enharmonic* Tetrachord) was likewiſe to them but as one uncompounded or entire Interval.

THESE were the Degrees *Chromatic* and *Enharmonic*: Tho' they alſo might be placed otherwiſe, *i. e.* the greater Degree in theſe may change its place, as the *Hemitone* (the leſs Degree) doth in the *Diatonic Genus*; and from this Change chiefly aroſe the ſeveral Moods, *Dorian*, *Lydian*, &c. From all which, their Muſic no doubt (tho' it be hard to us to conceive) muſt afford extraordinary Delight and Pleaſure, if it did bear but a reaſonable Proportion

to their infinite Curioſity and Labour. And as we may ſuppoſe it to have differ'd very much from that which now is, and for ſeveral Ages hath been uſed; ſo conſequently we may look upon it as in a manner loſt to us.

In proſecution of my Deſign, I am only, or chiefly, to inſiſt on the other Kind of Degrees, which are moſt proper to the Natural Explanation of Harmony, *viz.* the Degrees *Diatonic*; which are ſo call'd, not becauſe they are all *Tones*; but becauſe moſt of 'em, as many as can be, are ſuch; *viz.* in every *Diapaſon* five *Tones* and two *Hemitones*. Upon theſe, I ſay, I am to inſiſt, as being, of thoſe before mention'd, the moſt Natural and Rational.

Digreſſion.

But before we proceed, it may perhaps be a Satisfaction to the Reader, after what has been ſaid, to have a little better Proſpect of the ancient Greek Muſic, by ſome general Account; not of their whole Doctrine, but of that which relates to our preſent Subject, *viz.* their Degrees, and Scales of Harmony, and Notes.

First

First then, take out of *Euclid* the Degrees according to the three *Genera*; which were, *Enharmonic*, *Chromatic*, and *Diatonic*; which Kinds have ſix Colours (as they call'd them). *Euclid*, *Introd. Harm.* pag. 10.

The *Enharmonic* Kind had but one Colour, which made up its Tetrachord by theſe Intervals; a *Dieſis* (or quarter of a *Tone*) then ſuch another *Dieſis*, and alſo a *Ditone* incompoſit.

The *Chromatic* had three Colours, by which it was divided into *Molle*, *Seſcuplum*, and *Toniæum*.

1ſt, *Molle*, in which the Tetrachord roſe by a Triental *Dieſis* (four of thoſe twelve Parts mention'd before) or third part of a *Tone*; and another ſuch *Dieſis*; and an incompoſit Interval, containing a *Tone* and half, and third part of a *Toue*: And it was call'd *Molle*, becauſe it hath the leaſt, and conſequently moſt enervated *Spiſs* Intervals within the *Chromatic Genus*.

2d, *Seſcuplum*, by a *Dieſis* which is *Seſquialtera* to the *Enharmonic Dieſis*, and another ſuch *Dieſis*, and an Incompoſit Interval of ſeven *Dieſes* Quadrantal, *viz.* each being three Duodecimals of a *Tone*.

3d, *Toniæum*, by a *Hemitone*, and *Hemitone* and *Trihemitone*; and is call'd *Toniæum* because the two *Spiss* Intervals make a *Tone*. And this is the ordinary *Chromatic*.

THE *Diatonick* had two Colours; it was *Molle* and *Syntonum*.

1st, *Molle*; by a *Hemitone*, and an Incompositt Interval of three Quadrantal *Dieses* and an Interval of five such *Dieses*.

2d, *Syntonum*, by a *Hemitone* and a *Tone*, and a *Tone*. And this is the common *Diatonic*.

TO understand this better, I must reassume somewhat which I mention'd, but not fully enough before. A *Tone* is suppos'd to be divided into twelve least parts, and therefore a *Hemitone* contains six of those Duodecimal (or twelfth) parts of a *Tone*; a *Diesis Trientalis* 4, *Diesis Quadrantalis* 3, the whole *Diatessaron* 30. And the *Diatessaron* in each of the three Kinds was made and perform'd upon four Chords, having three mean Intervals of Degrees, according to the following Numbers and Proportions of those thirty Duodecimal parts.

Enhar-

Enharmonic, by 3, and 3, and 24

Chromatic,
- *Molle*, by 4, and 4, and 22.
- *Hemiolion*, or *Sesquiplum*, by $4\frac{1}{2}$, and $4\frac{1}{2}$, and 21.
- *Toniæum*, by 6, and 6, and 18.

Diatonic,
- *Molle*, by 6, and 9, and 15.
- *Syntonum*, by 6, and 12, and 12.

To each of these Kinds, and the Moods of them, they fitted a perfect System or Scale of Degrees to *Disdiapason*; as in the following Example taken out of *Nichomachus*; to which I have prefix'd our modern Letters.

E. Nichomacho, pag. 22.

A	*Nete Hyperbolæon.*	
G	*Paranete Hyperbolæon.*	*Enharm. Chro. Diat.*
F	*Trite Hyperbolæon.*	*Enh. Chro. Diat.*
E	*Nete Diezeugmenon.*	
D	*Paranete Diezeugmenon.*	*Enh. Chro. Diat.*
C	*Trite Diezeugmenon.*	*Enh. Chro. Diat.*
B	*Parameſe.*	

D	*Nete Synemmenon.*	
C	*Paranete Synemmenon.*	*Enh. Chro. Diat.*
B	*Trite Synemmenon.*	*Enh. Chro. Diat.*
A	*Meſe.*	
G	*Lichanos Meſon.*	*Enh. Chro. Diat.*
F	*Parypate Meſon.*	*Enh. Chro. Diat.*
E	*Hypate Meſon.*	
D	*Lychanos Hypaton.*	*Enh. Chro. Diat.*
C	*Parypate Hypaton.*	*Enh. Chro. Diat.*
B	*Hypate Hypaton.*	
A	*Proſlambanomenos.*	

In this Scale of *Diſdiapaſon* you ſee the *Meſe* is an *Octave* below the *Nete Hyperbolæon*, and an *Octave* above the *Proſlambanomenos:* And the *Lichanos*, *Parypate*, *Parenete*, and *Trite*, are changeable; as upon our Inſtruments are the Seconds, and Thirds, and Sixths, and Sevenths: The *Proſlambanomenos*, *Hypate*, *Meſe*, *Parameſe*, and *Nete*, are immutable; as are the Uniſon, Fourths, Fifths, and Octaves.

Now from the ſeveral Changes of theſe Mutable Chords chiefly ariſe the ſeveral Moods (ſome call'd them *Tones*) of Muſic, of which *Euclid* ſets down Thirteen; to which were joyn'd two more, *viz. Hyperæolian*

per æolian and *Hyperlydian*; and afterwards Six more were added.

I ſhall give you, for a Taſte, *Euclid*'s Thirteen Moods.

Euclid. p. 19.

Hypermixolydius, ſive *Hyperphrygius.*
Mixolydius acutior, ſive *Hyperiaſtius.*
Mixolydius gravior, ſive *Hyperdorius.*
Lydius acutior.
Lydias gravior, ſive *Æolius.*
Phrygias acutior.
Phrygius gravior, ſive *Iaſtius.*
Dorius.
Hypolydius acutior.
Hypolydius gravior, ſive *Hypoæolius.*
Hypophrygius acutior.
Hypophrygius gravior, ſive *Hypoiaſtius.*
Hypodorius.

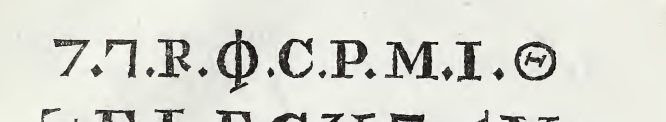
Of theſe the moſt grave, or loweſt, was the *Hyperdorian* Mood, the *Proſlambanomenos* whereof was fix'd upon the loweſt clear and firm Note, of the Voice or Inſtrument that was ſuppos'd to be of the deepeſt ſettled Pitch in Nature, and adapted freely to expreſs it: And then all-along from *Grave* to *Acute* the Moods took their Aſcent by *Hemitones*, each Mood being a *Hemi-*

Hemitone higher or more acute than the next under it. So that the *Proſlambanomenos* of the *Hypermixolydian* Mood was juſt an Eighth higher than that of the *Hypodorian*, and the reſt accordingly.

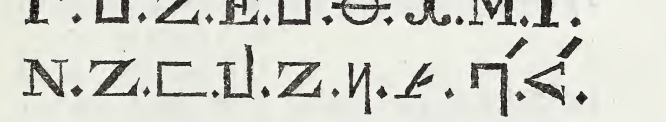
Now each particular Chord in the preceeding Scale had two Signs or Notes [σημεῖα] by which it was characteriz'd or deſcrib'd in every one of theſe Moods reſpectively; and alſo for all the Moods in the ſeveral Kinds of Muſic; *Enharmonic*, *Chromatic*, and *Diatonic*; of which two Notes, the upper was for reading [λέξις] the lower for percuſſion [κρέσις] one for the Voice, the other for the Hand. Conſider then how many Notes they uſed; 18 Chords ſeverally for 13 Moods (or rather 15, taking in the *Hyperæolian* and *Hyperlydian*, which are all deſcrib'd by *Alypius*) and theſe ſuited to the three Kinds of Muſic. So many Notes, and ſo appropriated, had the Scholar then to learn and conn who ſtudied Muſic. Of theſe I will give you in part a View out of *Alypius*.

Notes

Notes of the *Lydian* Mood in the *Diatonic Genus.*



1 2 3 4 5 6 7 8 9



10 11 12 13 14 15 16 17 18

1 *Proslambanomenos.* { *Zeta* imperfect, and *Tau* jacent.
2 *Hypate Hypaton.* { *Gamma* averted, and *Gamma* right.
3 *Parypate Hypaton.* { *Beta* imperfect, and *Gamma* inverted.
4 *Hypaton Diatonos.* *Phi*, and *Digamma.*
5 *Hypate Meson,* —— *Sigma*, and *Sigma.*
6 *Parypate Meson.*— *Rho*, & *Sigma* inverted.
7 *Meson Diatonos.*—*My*, and *Pi* drawn out.
8 *Mese.* —— —— *Iota*, and *Lamda* jacent

9 *Trite*

9 *Trite Synemmenon.* { *Theta*, and *Lambda* inverted.

10 *Synemmenon Diatonos.* *Gamma*, and *Ny.*

11 *Nete Synemmenon.* { Ω squared, lying supine upwards, and *Zeta.*

12 *Parameſe.* —— *Zeta* and *Pi* jacent.

13 *Trite Diezeugmenon* { E squared, and *Pi* inverted.

14 *Diezeugmenon Diatonos.* { Ω squared, supine, and *Zeta.*

15 *Nete Diezeugmenon.* { *Phi* jacent, and a careleſs *Eta* (ⁿ) drawn out.

16 *Trite Hyperbolæon.* { ϒ looking down, & *Alpha*, left half, looking upward.

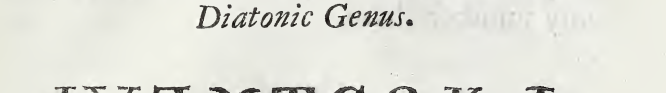
17 *Hyperbolæon Diatonos.* { *My*, and *Pi* lengthned, with an Acute above.

18 *Nete Hyperbolæon.* { *Iota*, and *Lambda* jacent, with an Acute above.

The Numeral Figures I have added under the Signs (or Marks) only for Reference to the Names of the Notes ſignified by them, to ſave deſcribing them twice.

Notes

Notes of the *Æolian* Mood in the *Diatonic Genus.*



1 2 3 4 5 6 7 8 9

10 11 12 13 14 15 16 17 18

1 *Proslambanomenos.* { *Eta* (H) imperfect averted, and Equadrate averted.

2 *Hypate Hypaton*, &c: { *Delta* inverted, and *Tau* jacent, averted, *&c.*

Aristides (Pag. 91.) enumerates and describes all the Variations of every Letter in the Greek Alphabet; by which the Signs or Notes above mention'd, and those of the other Moods, were contriv'd out of them.

them. They are in all 91; including the Proper Letters: I ſhall not deſcribe, but only number them.

Out of

	were made			were made
A	7	N		2
B	2	Ξ		2
Γ	7	O		2
Δ	4	Π		7
E	3	P		2
Z	2	Σ		6
H	5	T		4
Θ	2	Υ		3
I	4	Φ		4
K	3	X		4
Λ	5	Ψ		2
M	5	Ω		4
	49			42
	91			

I ſhall only add a Word or two concerning their ancient Uſe of the Words *Diaſtem* and *Syſtem*. *Diaſtem* ſignifies an Interval or Space; *Syſtem*, a Conjunction or Compoſition of Intervals. So that, generally ſpeaking, an *Octave*, or any other *Syſtem*, might be truly call'd a *Diaſtem*, and very frequently uſed to be ſo call'd, where there was no occaſion of Diſtinction. Tho' a *Tone*, or *Hemitone*, could not be call'd a *Syſtem*; for when they ſpoke ſtrictly, by a *Diaſtem* they underſtood only an Incom-

Incompoſit Degree, whether *Dieſis*, *Hemitone*, *Tone*, *Seſquitone*, or *Ditone*; for the two laſt were ſometimes but Degrees, one *Enharmonic*, the other *Chromatic*. By *Syſtem* they meant, a Comprehenſive Interval, compounded of Degrees, or of leſs *Syſtems*, or of both. Thus a *Tone* was a *Diaſtem*, and *Diateſſaron* was a *Syſtem*, compounded of Degrees, or of a 3^{d} and a Degree. *Diapaſon* was a *Syſtem*, compounded of the leſſer *Syſtems*, 4th, and 5th; or 3^{d} and 6th; or of a Scale of Degrees: And the Scale of Notes which they uſed, was their Greateſt, or Perfect *Syſtem*. Thus with them, a 3^{d} *Major*, and a 3^{d} *Minor*, in the *Diatonic Genus*, were (properly ſpeaking) *Syſtems*; the former being compounded of two *Tones*, and the latter of three *Hemitones*, or a *Tone* and *Hemitone*: But in the *Enharmonic* Kind, a *Ditone* was not a *Syſtem*, but an Incompoſit Degree; which added to two *Dieſes*, made up the *Diateſſaron*: And in the *Chromatic* Kind, a *Trihemitone* was the like; being only an Incompoſit *Diaſtem*, and not a *Syſtem*.

But to return from this Digreſſion (which is not ſo much to my Purpoſe, as to gratifie the Reader's Curioſity) and continue our Diſcourſe according to Nature's Guidance, upon the *Diatonic* Degrees. It

was ſaid, that there are five *Tones* and two *Hemitones* in every *Diapaſon*. Now the reaſon why there muſt be two *Hemitones*, is, becauſe an 8th is naturally compoſed of, and divided into 5th and 4th; and a Fifth is three *Tones* and a half; a Fourth two *Tones* and a half; and the Aſcent, by Degrees, muſt paſs by Fourth and Fifth; which are always unchangeable, and keep the ſame diſtance from *Uniſon*; and a juſt *Tone Major* of 9 to 8 always between them. Therefore the *Diapaſon* has not an Aſcent of ſix *Tones*, but of five *Tones* and two *Hemitones*, one *Hemitone* being placed in each Fourth Disjunct; in either of which Fourths, the Degrees may be alter'd by placing the *Hemitone* in the Firſt, or Second, or Third Degree of either. As, *MI, FA, Sol, La. La, MI, FA, Sol. Sol, La, MI, FA.* If this be done in the former *Tetrachord*, then is chang'd the Second, or Third *Chord*; if in the other Disjunct *Tetrachord*, then the Sixth, or Seventh is chang'd: The Fourth and Fifth being ſtable and immutable, by them we naturally divide the *Diapaſon*: The Second, Third, Sixth, and Seventh are alterable, as *Minor*, and *Major*, according to the Place of the *Hemitone*.

THESE *Tones* and *Hemitones* thus placed, are the Degrees or Notes by which

an

an Aſcent or Deſcent is made from the *Uniſon* to the *Octave*, or thro' any other *Syſtem*, giving all the Concords their juſt Meaſures or Rations; and without which, we could neither Meaſure, nor Divide, nor well Practiſe, to learn the greater *Intervals* or *Syſtems*.

As we Naturally by the Judgment of our Ear, own, and reſt in the *Octave*, as the chief Conſonant; ſo we do as Naturally (without Study or Skill in Muſic) meaſure the *Syſtem* of a *Diapaſon* by theſe *Diatonic* Degrees; and can do no otherwiſe. We cannot with our Voice, without infinite Study, frame to run up or down eight Notes, without ſuch a Mixture of *Tones* and *Hemitones*; and we do it eaſieſt when we avoid *Tritones*. We ſee it in a Ring of Bells, of which the compleateſt and moſt pleaſant is a Peal of Six; which are beſt ſorted to have the *Hemitone* in the midſt; *i. e.* between the Third and Fourth, both in Aſcending and Deſcending; and then there will be no *Tritone*: Ex. gr. *La*, *Sol*, *Fa*, *Mi*, *Re*, *Ut*. Where all Aſcents and Deſcents are made by juſt *Diateſſarons*. *Ut*, *Re*, *Mi*, *Fa*. *Re*, *Mi*, *Fa*, *Sol*. *Mi*, *Fa*, *Sol*, *La*. Or downwards; *La*, *Sol*, *Fa*, *Mi*. *Sol*, *Fa*, *Mi*, *Re*. *Fa*, *Mi*, *Re*, *Ut*.

And this is ſo Natural that it pleaſeth all Ears; and if they ſhould be diſpoſed in any other Order, it would be ſo diſagreeable, that any Ruſtick or unlearn'd Ear, of ſuch as know not what a *Tritone* is, would be able to judge, and find a Diſlike of it. But then, how much more, if the Ring of Bells were diſpos'd by *Chromatic* or *Enharmonic* Degrees, conſtituting the *Diateſſarons*? how abſurd and uncouth it would appear! The practiſe of thoſe kinds therefore, and in ſuch a manner, ſeems to be (as has been ſaid) a Violence upon Nature, and only for Curioſity.

In *Diatonic* Muſic there is but one ſort of *Hemitone* amongſt the Degrees, call'd *Hemitone Major*, whoſe Ration is 16 to 15; being the Difference, and making a Degree between a *Tone Major* and Third *Minor*; or between a Third *Major* and a Fourth.

There are two ſorts of *Tones*; viz. *Major*, and *Minor*. *Tone Major* (9 to 8) being the Difference between a Fourth and Fifth: And *Tone Minor* (10 to 9) which is the Difference between Third *Minor* and Fourth. But both the *Tones* ariſing (as hath been ſaid) out of the Partition of a Third *Major*, in like manner as 5^{th} and 4^{th} do by the Partition of an 8^{th}: I may (with ſub-

ſubmiſſion) make the following Remark; wherein, if I be too bold, or be miſtaken, I ſhall beg the Reader's Pardon.

THE ancient *Greek* Maſters found out the *Tone* by the Difference of a Fourth and Fifth, ſubſtracting one from the other: But had they found it alſo (and that more Naturally) by the Diviſion of a Fifth; firſt into a *Ditone* and *Seſquitone*, and then by the like proper Diviſion of a true *Ditone* (or Third *Major*) into its proper Parts; they muſt have found both *Tone Major* and *Tone Minor*. *Euclid* reſts ſatisfied, that *Inter ſuper-particulare non cadit Medium.* A ſuper-particular Ration cannot have a Mediety; *viz.* in whole Number: Which is true in its Radical Numbers. But had he doubled the Radical Terms of a Super-particular, he might have found Mediums moſt Naturally and Uniformly dividing the Syſtems of Harmony; *ex. gr.* The Duple Ration 2 to 1, as the Exceſs is but by an Unity, has the Nature of Super-particular: but 2 to 1, the Terms being dupled, is 4 to 2; where 3 is a Medium, which divides it into 4 to 3 (4^{th}) and 3 to 2 ($5^{th.}$) Again, 3 to 2, dupling each Term, is 6 to 4; and in the ſame manner gives the two Thirds, *viz.* 6 to 5, (3^{d} *Minor*) and 5 to 4, (3^{d} *Major*). Likewiſe the 3^{d} *Major*, 5 to 4,

dupled as before, 10 to 8, gives the two *Tones*; *i. e.* 10 to 9, *Tone Minor*, and 9 to 8, *Tone Major*.

And it ſeems to be a Reaſon why the Ancients did not diſcover and uſe the *Tone Minor*, and conſequently not own the *Ditone* for a Concord; becauſe they did not purſue this Way of dividing the *Syſtems*. Altho' *Euclid* had a fair Hint to ſearch further, when he meaſured the *Diapaſon* by ſix *Tones* [*Major*] and found them to exceed the Interval of *Diapaſon*.

The *Pythagoreans*, not uſing *Tone Minor*, but two equal *Tones Major*, in a Fourth, were forced to take a leſſer Interval for the *Hemitone*; which is call'd their *Limma*, or *Pythagorean Hemitone*; and, which added to thoſe two *Tones*, makes up the Fourth: 'Tis a *Comma* leſs than *Hemitone Major*, (16 to 15) and the Ration of it is 256 to 243.

Yet we find the later *Greek* Maſters, *Ptolemy*, to take Notice of *Tone Minor*; and *Ariſtides Quintilianus*, to divide a *Seſquioctave Tone* (9 to 8) by dupling the Terms of the Ration thereof into two *Hemitones*; 18 to 17, and 17 to 16. And thoſe again, by the ſame Way, each into two

Dieſes;

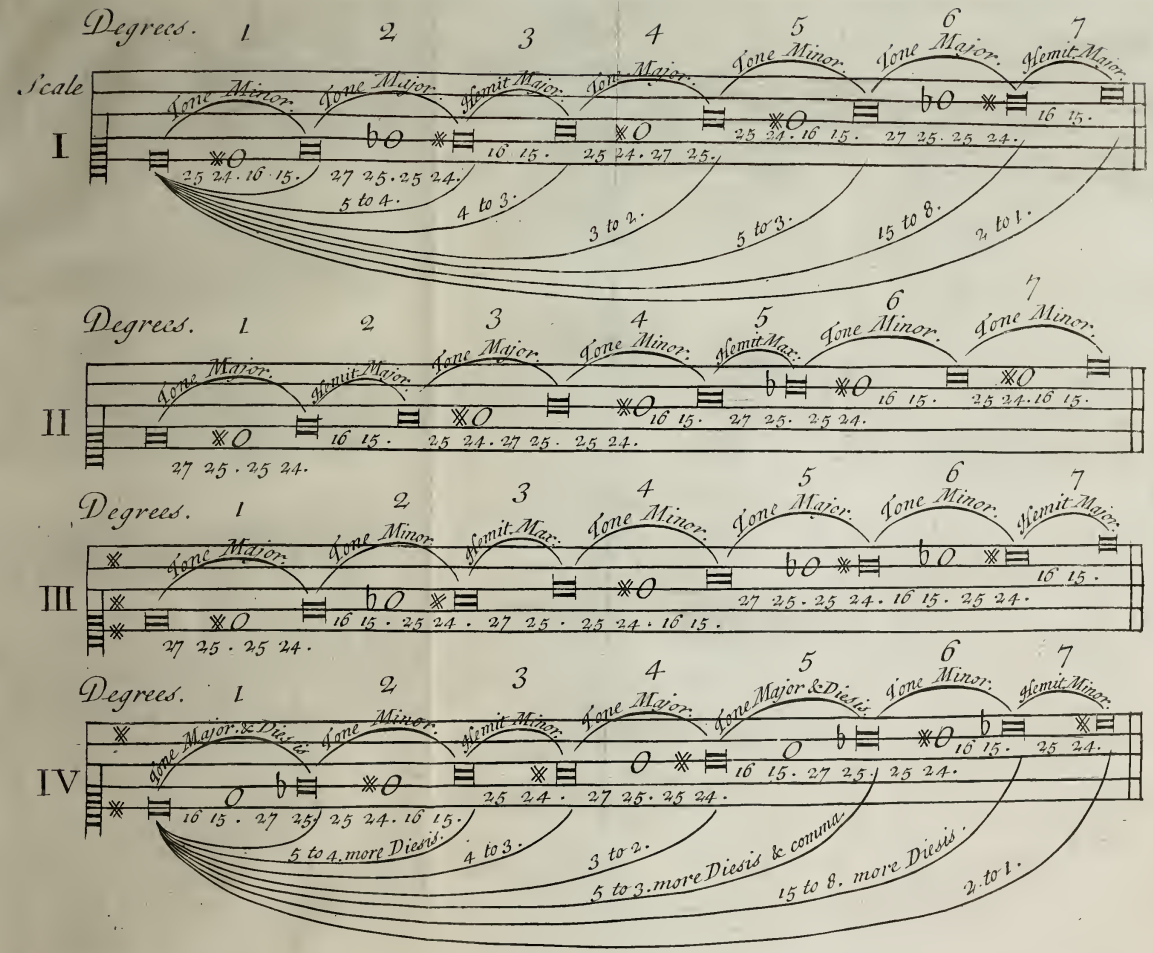
Dieſes; 36 to 35, 35 to 34; the Diviſion of 18 to 17, the leſs *Hemitone*: And 34 to 33, and 33 to 32; the Parts of 17 to 16, the greater *Hemitone*. But yet, none of theſe were the Complement of two *Seſquioctave Tones* to *Diateſſaron*: but another *Hemitone*, whoſe Ratio is about 20 to 19; not exactly, but ſo near it, that the Difference is only 1216 to 1215; both which together make the *Limma Pythagoricum*.

But I no where find, that they thus divided the Fifth and Third *major*, but rather ſeem'd to diſlike this Way, becauſe of the Inequality of the *Hemitones* and *Dieſes* thus found out; and choſe rather to conſtitute their Degrees by the *Seſquioctave Tone*, and thoſe Duodecimal ſuppos'd-equal Diviſions of it. But to return.

There are, you ſee, three Degrees *Diatonic*; viz. *Hemitone major*, *Tone minor*, and *Tone major*. The firſt of theſe ſome call *Degree minor*; the ſecond, *Degree major*; the third, *Degree maxim*. Now theſe three ſorts of Degrees are properly to be intermix'd, and order'd, in every Aſcent to an Eighth, in relation to the Key, or Uniſon given, and to the Affections of that Key, as to Flat and Sharp, in our Scale of Muſic; ſo, that the Concords may be all

true, and ſtand in their own ſettled Ration. Wherefore if you change the Key, they muſt be changed too ; which is the reaſon why a Harpſichord, whoſe Degrees are fixed ; or a fretted Inſtrument, the Frets remaining fix'd, cannot at once be ſet in Tune for all Keys : For, if you change the Key, you withal change the Place of *Tone minor*, and *Tone major*, and fall into other *Hemitones* that are not proper *Diatonic* Degrees, and conſequently into falſe Intervals.

You may fully ſee this, if you draw Scales of Aſcent fitted to ſeveral Keys (as are here inſerted) and compare them. For an Example of this, Take the firſt Scale of Aſcent to *Diapaſon* [I] *viz.* upon C Key Proper, by *Diatonic* Degrees ; (making the firſt to be *Tone minor*, as convenient for this Inſtance) intermixing the *Chromatic* and other *Hemitones*, as they are uſually placed in the Keys of an Organ ; *i. e.* run up an Eighth upon an Organ (tuned as well as you can) by Half-Notes, beginning at C *Sol fa ut*, and you will find theſe Meaſures. The Proper Degrees ſtanding right, as they ought to be, being deſcrib'd by *Breves* ; the other by *Semibreves* : The *Breves* repreſenting the *Tones* of the broad Gradual Keys of an Organ ; the *Semibreves* repre-



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repreſenting the narrow Upper Keys, which are uſually call'd *Muſics*. And let this be the firſt Scale, and a Standard to the reſt.

THEN draw a ſecond Scale [II] running up an Eighth in like manner; but let the Key, or Firſt Note be D *Sol re*, with a Flat Sixth, on the ſame Organ ſtanding tuned as before; which Key is ſet a Note (or *Tone Minor*) higher than the former.

DRAW alſo a third Scale [III] for D *Sol re* Key with Sharps, *viz.* Third and Seventh *Major*; *i. e.* F, and C, ſharp.

IN the Firſt of theſe Scales, the Degrees (expreſs'd by *Breves*) are ſet in good and natural Order.

IN the Second Scale (changing the Key from C to D) you will find the Second, Fourth, and Sixth, a *Comma* (81 to 80) too much; but between the Fourth and Fifth, a *Tone Minor*, which ſhould be always a *Tone Major*. So, from the Fourth to the Eighth, is a *Comma* ſhort of *Diapente*, and from the Sixth, a *Comma* ſhort of Third *Major*. And this, becauſe in this Scale the Degrees are miſplaced.

THE

THE Third Scale makes the Second, Fourth, and Sixth, from the *Uniſon*, each a *Comma* too much; and from the *Octave*, as much too little. In it, the third Degree, between ♯F and G, is not the Proper *Hemitone*, but the Greateſt *Hemitone*, 27 to 25. And all this, becauſe in this Scale alſo the Degrees are miſplaced; and there happen (as you may ſee) three *Tones Minor*, and but two *Major*; the deficient *Comma* being added to the *Hemitone*.

I have added one Example more, of a Fourth Scale; [IV] *viz.* beginning at the Key ♯C; with the like Order of Degrees as in the firſt Scale (from the Note C ♯) upon the ſame Inſtrument, as it ſtands tuned after the firſt Scale: And this will raiſe the firſt Scale half a Note higher.

IN this Scale, all the *Hemitones* are of the ſame Meaſure with thoſe of the firſt Scale reſpectively.

AND the Intervals ſhould be the ſame with thoſe of the firſt Scale; which has Third, Sixth, Seventh, *Major*.

BUT in this fourth Scale, the firſt Degree, from ♯C to ♭E, is *Tone major*, and *Dieſis*;

Dieſis; as being compounded of 16 to 15, and 27 to 25.

THE Second Degree from ♭E to F, is *Tone Minor*; therefore the *Ditone*, made by theſe two Degrees, is too much by a *Dieſis*, (128 to 125) and as much too little the *Trihemitone*, from the *Ditone* to the Fifth.

THE Third Degree, from F to ♯F, is a *Minor Hemitone*, 25 to 24; which (tho' a wrong Degree) ſets the *Diateſſaron* right.

THE Fourth Degree; from ♯F to ♯G, is *Tone Major*, and makes a true Fifth.

THE Fifth Degree, from ♯G to ♭B, is *Tone major*, and *Dieſis*; ſetting the *Hexachord* (or Sixth) a *Dieſis* and *Comma* too much, or too high. It ought to have been *Tone minor*.

THE Sixth, from ♭B to C, is *Tone minor*; too little in that place by a *Comma*.

THE Seventh, from C to ♯C, is *Hemitone Minor*; too little by a *Dieſis*. And ſo, theſe two laſt Degrees are deficient by

a *Dieſis* and *Comma*; which *Dieſis* and *Comma* being Redundant (as before) in the fifth Degree, are balanced by the deficiency of a *Comma* in the ſixth Degree, and of a *Dieſis* in the ſeventh: And ſo the *Octave* is ſet right.

THESE Diſagreements may be better view'd, if we ſet together, and compare the Degrees of this IV Scale, and thoſe of the I: Where we ſhall find but one of all the ſeven Degrees, to be the ſame in both Scales.

Degrees.	Scale I.	Scale IV.
1ſt,	*Tone minor.*	*Tone maj.* and *Dieſis.*
2d,	*Tone major.*	*Tone minor.*
3d,	*Hemit. major.*	*Hemitone minor.*
4th,	*Tone major.*	*Tone major.*
5th,	*Tone minor.*	*Tone maj.* and *Dieſis.*
6th,	*Tone major.*	*Tone minor.*
7th,	*Hemit. major.*	*Hemitone minor.*

AND thus 'twill ſucceed in all Inſtruments, tuned in order by *Hemitones*, which are fix'd upon Strings; as Harp, *&c.* or Strings with Keys; as Organ, Harpſichord, *&c.* or diſtinguiſh'd by Fretts; as Lute, Viol, *&c.* for which there is no Remedy, but by ſome alterations of the Tune of the Strings

Strings in the two former; and of the Space of the Fretts in the latter; as your present Key will require, when you change from one Key to another, in performing Musical Compositions.

THO' the Voice, in Singing, being free, is naturally guided to avoid and correct those before describ'd *Anomalies*, and to move in the true and proper Intervals: It being much easier with the Voice to hit upon the right, than upon the *anomalous* or wrong Spaces.

MUCH more of this Nature may be found, if you make and compare more Scales from other Keys. You will still find, that, by changing the Key, you do withal change and displace the Degrees, and make use of Improper Degrees, and produce Incongruous Intervals.

FOR, instead of the Proper *Hemitone*, some of the Degrees will be made of other sort of *Hemitones*; amongst which chiefly are these two: *viz. Hemitone Maxim.* 27 to 25; and *Hemitone Minor*, or *Chromatic*, 25 to 24. Which *Hemitones* constitute and divide the two *Tones*; *viz. Tone major*, 9 to 8: the Terms whereof tripled, are 27 to 24; and give 27 to 25, and 25 to 24.

The

The *Tone minor* likewiſe is divided into two *Hemitones*; viz. *Major*, 16 to 15; and *Minor*, 25 to 24.

THESE two ſerve to meaſure the *Tones*, and are uſed alſo when you Divert into the *Chromatic* Kind. But the *Hemitone* Degree in the *Diatonic Genus*, ought always to be *Hemitone Major*, 16 to 15; as being the Proper Degree and Difference between *Tone major* and *Trihemitone*, between *Ditone* and a Fourth, between Fifth and Sixth *minor*, and alſo between Seventh *major* and *Octave*.

MUSIC would have ſeem'd much eaſier, if the Progreſſion of Dividing had reach'd the *Hemitones*: I mean, if, as by dupling the Terms of *Diapaſon*, 4 to 2; it divides in 4 to 3, and 3 to 2; *Diateſſaron*, and *Diapente*: And the Terms of *Diapente* dupled, 6 to 4; fall into 6 to 5, and 5 to 4, Third *minor*, and Third *major*; and *Ditone*, or Third *major*; ſo dupled, 10 to 8, falls into 10 to 9, and 9 to 8, Tone *minor* and Tone *major*: If, I ſay, in like manner, the dupled Terms of Tone *major* 18 to 16, thus divided, had given Uſeful and Proper *Hemitones*, 18 to 17, and 17 to 16. But there are no ſuch *Hemitones* found in Harmony, and we are put to ſeek the *Hemitones* out of

of the Differences of other Intervals; as we ſhall have more Occaſion to ſee, when I come to treat of Differences, in *Chap.* 8.

I may conclude this Chapter, by ſhewing how *all* Conſonants, and other Concinnous Intervals, are Compounded of theſe three Degrees; *Tone major*, *Tone minor*, and *Hemitone major*; being ſeverally placed, as the Key ſhall require.

Tone Major, and *Hemitone Major*, joyn'd, make 3d *Minor*.

Tone Major, and *Tone Minor*, joyn'd, make 3d *Major*.

Tone Major, and *Tone Minor*, and *Hemitone Major*, joyn'd, make 4th.

2 *Tones Major*, 1 *Tone Minor*, 1 *Hemitone Maj.* joyn'd, make 5th.

2 *Tones Major*, 1 *Tone Minor*, 2 *Hemitones Maj.* joyn'd, make 6th *Minor*.

2 *Tones Major*, 2 *Tones Minor*, 1 *Hemitone Maj.* joyn'd, make 6th *Major*.

3 *Tones*

3 *Tones Major*, 1 *Tone Minor*, & 2 *Hemitones* Maj. } joyn'd, make } 7th *Minor.*

3 *Tones Major*, 2 *Tones Minor*, 1 *Hemitone Maj.* } joyn'd, make } 7th *Major.*

3 *Tones Major*, 2 *Tones Minor*, 2 *Hemitones Maj.* } joyn'd, make } *Diapaſon.*

2 *Tones Major*, 1 *Tone Minor*, } joyn'd, make } *Tritone*, or falſe 4th.

1 *Tone Major*, 1 *Tone Minor*, 2 *Hemit. Major*, } joyn'd, make } *Semidiapente*, or falſe 5th.

CHAP. VII.

Of Diſcords.

BESIDES the Degrees, which, tho' they conſtitute and compound all Concords, yet are reckon'd amongſt Diſcords; becauſe every Degree is Diſcord to each Chord, to, or from which it is a Degree, either Aſcending or Deſcending, as being a Second to it: Beſides theſe, I ſay, there are other Diſcords, ſome greater, and ſome leſs.

leſs. The leſs will be found amongſt the Differences in the next Chapter ; and are fit, rather to be known as Differences, than to be uſed as Intervals.

THE greater Diſcords are generally made of ſuch Concords as, by reaſon of miſplaced Degrees happen to have a *Comma*, or *Dieſis*, or ſometimes a *Hemitone* too much, or too little ; and ſo become Diſcords, moſt of them being of little Uſe, only to know them, for the better meaſuring and rectifying the *Syſtems:* Yet they are found amongſt the Scales of our Muſic.

SOMETIMES a *Tone Major* being where a *Tone Minor* ſhould have been placed, or a *Tone Minor* inſtead of a *Tone Major* ; ſometime other *Hemitones*, getting the place of the *Diatonic Hemitone Major*, and ſerving for a Degree, create unapt Diſcording Intervals : amongſt which may be found at leaſt two more Seconds, two more Thirds, two more Sixths, and two more Sevenths. In each of which, one is leſs, and the other greater, than the true legitimate Intervals, or Spaces of thoſe Denominations ; as will be more explain'd in the enſuing Diſcourſe.

BUT beſides theſe (or rather amongſt them, for I here treat of Degrees as Diſcords) there are two Diſcords eminently conſiderable, *viz. Tritone*, and *Semidiapente*. The *Tritone*, (or falſe Fourth) whoſe Ration is 45 to 32, conſiſts of three whole Notes; *viz.* two *Tones Major*, and one *Minor*. The *Semidiapente* (or falſe Fifth) 64 to 45; is compounded of a Fourth and *Hemitone Major*.

AND theſe two divide *Diapaſon*, 64 to 32, by the Mediety of 45; And they divide it ſo near to Equality, that in Practice they are hardly to be diſtinguiſh'd, and may almoſt paſs for one and the ſame: but in Nature, they are ſufficiently diſtinguiſh'd; as may be ſeen both by their ſeveral Rations, and ſeveral Compounding Parts.

I think we may reckon 7ths for Degrees, as well as among the greater Diſcording Intervals; becauſe they are but *Seconds* from the *Octave*, and are as truly Degrees Deſcending, as the *Seconds* are in Aſcent: tho' they be great Intervals in reſpect of the *Uniſon*, and ſuch as may be here regarded.

THESE Diſcords, the *Tritone*, and *Semidiapente*; as alſo, the Seconds, and Sevenths, are

are of very great uſe in Muſic, and add a wonderful Ornament and Pleaſure to it, if they be judiciouſly managed. Without them, Muſic would be much leſs grateful; like as Meat would be to the Palate without Salt or Sawce. But, the further Conſideration of this, and to give Directions when, and how to uſe 'em, is not my Task, but muſt be left to the Maſters of Compoſition.

DISCORDS then, ſuch as are more apt and uſeful *(Intervalla Concinna)* are theſe which follow.

2d *Minor*;	or, *Hemitone Major*,	16 to 15.
2d *Major*;	*Tone Minor*,	10 to 9.
2d *Greateſt*;	*Tone Major*	9 to 8.
7th *Minor*;	5th & 3d *Minor*,	9 to 5.
7th *Major*;	5th & 3d *Major*,	15 to 8.
Tritone;	3d *Maj.* & *Tone Maj.*	45 to 32.
Semidiapente;	4th & *Hemit. Maj.*	64 to 45.

THESE are the Simple diſſonant apt Intervals within *Diapaſon*; if you go a further Compaſs, you do but repeat the ſame Intervals added to *Diapaſon*, or *Diſ-diapaſon*, or *Triſ-diapaſon*, &c. as, *Ex. gr.*

A 9th	is *Diapaſon* with a 2d.
10th	*Diapaſon* with a 3d.
11th	*Diapaſon* with a 4th, or *Diapaſon cum Diateſſaron.*
12th	*Diapaſon* with a 5th, or *Diapaſon cum Diapente.*
15th	*Diſ-diapaſon.*
19th	*Diſ-diapaſon cum Diapente.*
22th	*Triſ-diapaſon*, &c.

HERE, by the way, the Reader may take a little Diverſion, in practiſing to meaſure the Rations of ſome of thoſe Intervals in the 'foregoing Catalogue of Diſcords, by comparing them with *Diapaſon*; as thoſe of the *Sevenths*, which I ſelect, becauſe they are the moſt diſtant Rations under *Diapaſon*; viz. *Seventh minor*, 9 to 5; and *Seventh major*, 15 to 8. Now to find what Degree or Interval lies between theſe and *Diapaſon.*

Firſt, 9 to 5 is 10 to 5, wanting 10 to 9 (*Tone minor.*) Next, 15 to 8 is 16 to 8, wanting 16 to 15 (*Hemitone major.*) So the Degree between *Seventh minor* and *Diapaſon*, is *Tone minor*; and between *Seventh major* and *Diapaſon*, is *Hemitone major.*

THEN

THEN he may exercise himself in a Survey of what Intervals are compriz'd in those several *Sevenths*, and of which they are compounded.

FIRST, 9 to 5 comprizeth 9 to 8, and 8 to 5: Or, 9 to 8, 8 to 6, and 6 to 5. Next, 15 to 8 contain 15 to 12, 12 to 10, 10 to 9, and 9 to 8: Or, 15 to 12, and 12 to 8: Or, 15 to 10, and 10 to 8, *&c.* I suppose that the Reader, before this, is so perfect in these Rations, that I need not lose Time to name the Intervals expres's'd by the Mean Rations, contain'd in the 'foregoing Rations of the *Sevenths*, which shew of what Intervals the several *Sevenths* are compounded.

BESIDES these (by reason of Degrees wrong placed) there are two more *Sevenths*; [*false Sevenths*] one, less than the true ones, and another greater. The least compounded of two *Fourths*, whose Ration is 16 to 9, and wants a *Comma* of *Seventh minor*, and a *Tone major* of *Diapason:* The other is the greatest, call'd *Semidiapason*, whose Ration is 48 to 25; being a *Diesis* more than *Seventh major*, and wanting *Hemitone minor* of *Diapason*.

Now, first, 16 to 9 is 16 to 8 (2 to 1) wanting 9 to 8; *i. e.* wanting *Tone major* of *Diapason*; and contains 16 to 10 (8 to 5) and 10 to 9: Or, 16 to 15, 15 to 12 (5 to 4) 12 to 10 (6 to 5) and 10 to 9. Next, *Semidiapason* 48 to 25, is 50 to 25, wanting 50 to 48; *i. e.* 25 to 24 (viz. *Hemitone minor*) of *Diapason*.

And the like happens, as hath been said, to the other Intervals, which admit of *major* and *minor*; viz. *Seconds*, *Thirds*, and *Sixths*. The *Fourth*, and *Fifth*, and *Eighth* ought always to remain immutable; tho' they may suffer too sometimes, and incline to Discord, if we ascend to them by very wrong Degrees; as you may see in the II[d] Scale in the 'foregoing Chapter; where the *Fourth* having two *Tones major*, is a *Comma* too much.

All these Intervals may be subject to more Mutations, by more absurd placing of Degrees, or of Differences of Degrees; but it is not worth the Curiosity to search farther into them: The Reader may take Pleasure, and sufficiently exercise himself, in comparing and measuring these which are already laid before him.

But

BUT to return from this Digreſſion. There are many unapt Diſcords, which may ariſe by continual Progreſſion of the ſame Concords; *i. e.* by adding (for Example) a *Fourth* to a *Fourth*, a *Fifth* to a *Fifth*, &c. for 'tis obſervable, That only *Diapaſon* added (as oft as you pleaſe) to *Diapaſon*, ſtill makes Concord: But any other Concord, added to it ſelf, makes Diſcord.

YOU will ſee the Reaſon of it, when you have conſider'd well the Anatomy (as I may call it) of the Conſtitutive Parts of *Diapaſon*; which contains, and is compos'd of ſeven Spaces of Degrees, or of *Fourth* and *Fifth*, or of *Thirds* and *Sixths*, or of *Seconds* and *Sevenths*; which muſt all keep their true Meaſures and Rations belonging to them, and otherwiſe are eaſily and often diſorder'd.

THEN, conſider *Diapaſon* as conſtituted of two *Fourths* disjunct, and a *Tone major* between 'em. And this laſt is moſt needful to be very well conſider'd; as moſt plainly ſhewing the Reaſons of thoſe Anomalies, or irregular Intervals, which are produced by changing the Key, and conſequently giving a new and wrong Place to this odd *Tone major*, which ſtands in the

midſt of *Diapaſon*, between the two *Fourths* disjunct.

Every *Fourth* muſt conſiſt of one *Tone major*, one *Tone minor*, and one *Hemitone major*, as its Degrees, placing them in what Order you pleaſe; whoſe Rations, added together, make the Ration of *Diateſſaron*. And of theſe ſame Degrees contain'd in the *Fourth*, are made the two *Thirds*, which conſtitute the *Fifth*. *Tone major* and *Hemitone major* make the leſs Third, or *Trihemitone*; *Tone major* and *Tone minor* make the greater Third, or *Ditone*; *Trihemitone* and *Ditone* make *Diapente*; *Trihemitone* and *Tone Minor* (as likewiſe *Ditone* and *Hemitone major*) make *Diateſſaron*.

Now this *Tone Major*, that ſtands in the middle of *Diapaſon*, between the two *Fourths*, which it disjoins; and the Degrees requir'd to the *Fourths*, will not in a fixed Scale ſtand right, when you alter your Key, and begin your Scale of *Diapaſon* from another Note: For that which was the *Fifth*, will now be the *Fourth*, or *Sixth*, &c. and then the Degrees will be diſorder'd, and create ſome diſcording Intervals. If you continue conjunct *Fourths*, there will be a Defect of *Tones Major*; if you continue conjunct *Fifths*, there will be too many *Tones Major*

Major in the Syſtems produced. And if a *Tone Major* be found, where it ought to have been a *Tone Minor*; or a *Minor* inſtead of a *Major*; that Interval will have a *Comma* too much, or too little. And ſo likewiſe will from a wrong *Hemitone* be found the Difference of a *Dieſis*. And theſe two, *Comma* and *Dieſis*, are ſo often redundant, or deficient, according as the Degrees happen to be diſorder'd or miſplaced; that thereby the Difficulties of fixing half-Notes of an Organ in tune for all Keys, or giving the true Tune by Fretts, become ſo inſuperable.

You ſee, that in every Space of an Eighth, there are to be three *Tones major*, and two *Tones minor*, and two *Hemitones major*: One *Tone major* between the *Diateſſaron* and *Diapente*, and a *Tone major*, a *Tone minor*, and *Hemitone major* in each of the disjunct Fourths.

These are the proper Degrees by which you ſhould always Aſcend or Deſcend thro' *Diapaſon*, in the *Diatonic* Kind; which *Diapaſon* being the compleat Syſtem, containing all primary Simple *Harmonic* Intervals that are; (and for that reaſon call'd *Diapaſon*;) you may multiply it, or add it to its ſelf as oft as you pleaſe, as far as Voice

or

or Inſtrument can reach, and it will ſtill be Concord, and cannot be diſorder'd by ſuch Addition; becauſe every of them will contain (however placed) juſt three *Tones major*, two *Tones minor*, and two *Hemitones major*.

WHEREAS, if you add any other Interval to itſelf, the Degrees will not fall right, and it will be Diſcord, becauſe all Concords are compounded of unequal Parts, as hath been ſhewn before; and if you carry them in equal Progreſſion, they will mix with other Intervals by incongruous Degrees, and thoſe diſorder'd Degrees will create a diſſonant Interval. See the following Scheme of it.

2 3ds *minor*	make	5th, wanting *Hemit. min.*
2 3ds *major*		5th, and *Hemit. minor.*
2 4ths		8th, wanting *Tone major.*
2 5ths		8th, and *Tone major.*
2 6ths *minor*		8th, and *Ditone*, & *Dieſis.*
2 6ths *major*		8th, and 4th, & *Hem. min.*

To which may be added, That

2 *Tones min.*	make	*Ditone*, wanting a *Comma.*
2 *Tones maj.*		*Ditone*, and a *Comma.*

IT was ſaid above, That *Diapaſon* may be added to it ſelf as oft as you pleaſe, and there

there will be no Diſorder, becauſe every one of 'em will ſtill retain the ſame Degrees of which the firſt was compos'd: But it is not ſo in other Concords; of which I will add one more Example, becauſe of the Uſe which may be made of it.

MAKE a Progreſſion of four *Diapente's*, and, as was ſhew'd in the Fifth Chapter, it will produce *Diſdiapaſon*, and two *Tones major*, which is a 17th, with a *Comma* too much; becauſe in that Space there ought to be juſt ſeven *Tones major*, and five *Tones minor*; whereas in four *Fifths* continued, there will be found eight *Tones major*, and but four *Tones minor*: So that a *Tone major*, getting the Place of a *Tone minor*, there will be in the whole Syſtem a *Comma* too much. One of theſe *major Tones* ſhould have been a *Tone minor*, to make the Exceſs above *Diſdiapaſon* a juſt *Ditone*.

ON the other ſide, if you continue the Ration of four *Diateſſarons*, there will be a *Tone minor*, inſtead of a *Tone major*; and conſequently a *Comma* deficient in conſtituting *Diapaſon* and *Sixth minor*. For ſince every *Fourth* muſt conſiſt of the Degrees of *Tone minor*, one *Tone major*, one *Hemitone major*; it follows, that if you continue four *Fourths*, there will be four *Tones minor*, four

Tones

Tones major, and four *Hemitones major*: Whereas in the Interval of *Diapaſon* with *Sixth minor*, there ought to be five *Tones major*, and but three *minor*.

By this you may ſee the Reaſon, why, to put an Organ or Harpſichord into more general uſeful Tune, you muſt tune by *Eighths* and *Fifths*; making the *Eighths* perfect, and the *Fifths* a little bearing downward; *i. e.* as much as a quarter of a *Comma*, which the Ear will bear with in a *Fifth*, tho' not in an *Eighth*. For Example, begin at C *Fa ut*; make C *Sol fa ut* a perfect *Eighth* to it, and G *Sol re ut* a bearing *Fifth*; then tune a perfect *Eighth* to G, and a bearing *Fifth* at D *La ſol re*; and from thence downwards (that you may keep towards the middle of the Inſtrument) a perfect *Eighth* at D *Sol re*: And from thence a bearing *Fifth* up at A; and from A, a perfect *Eighth* upwards, and bearing *Fifth* at E *La mi*. From E an *Eighth* downwards; and ſo go on, as far as you are led by this Method, to tune all the middle part of the Inſtrument; and at laſt fill up all above, and below, by *Eighths* from thoſe which are ſettled in Tune, according to the Scheme annex'd; obſerving (as was ſaid) to tune the *Eighths* perfect, and the *Fifths* a little bearing flat; except in the three

laſt

laſt Barrs of *Fifths*, where the *Fifths* begin to be taken downward from C, as they were upwards in all before: Therefore, as before, the *Fifth* above bore downward; ſo here, the *Fifth* below muſt bear upward, to make a bearing *Fifth*: but that being not ſo eaſie to be judg'd, alter the Note below, till you judge the Note above to be a bearing *Fifth* to it. This will rectifie both thoſe Anomalies of *Fifths* and *Fourths*: For the *Fifth* to the *Uniſon*, is a *Fourth* to the *Octave*; and what the *Fifth* loſeth by Abatement, the *Fourth* will gain: Which doth in a good Degree rectifie the Scale of the Inſtrument. Taking Care withal, that what Anomalies will ſtill be found in this *Hemitonic* Scale, may, by the Judgment of your Ear, in tuning, be thrown upon ſuch Chords as are leaſt uſed for the Key; as ♯ G, *b* E, *&c.* even which the Ear will bear with, as it doth with other Diſcords in binding Paſſages; if ſo, you cloſe not upon them. But the other Diſcords, ſo uſed, are moſt Elegant; theſe only more Tolerable.

CHAP.

CHAP. VIII.

Of Differences.

ALL Rations and Proportions of Inequality, have a Difference between them, when compar'd to one another; and conſequently the Intervals, expreſs'd by thoſe Rations, differ likewiſe. A *Fifth* is different from a *Fourth*, by a *Tone Major*; from a Third *Minor*, by a Third *Major*; ſo an Eighth from a Fifth, by a Fourth. Of the Compounding Parts of any Interval, one of them is the Difference between the other Part and the whole Interval.

BUT I treat now of ſuch Differences as are generally leſs than a *Tone*, and create the Difficulties and Anomalies occurring in the two 'foregoing Chapters. I have the leſs to ſay of them apart, becauſe I could not avoid touching upon them all-along. 'Twill only therefore be needful, to ſet before you an orderly View of them. And, firſt, taking an Account of the true *Harmonic Intervals*, with their Differences, and the Degrees by which they ariſe; 'twill be eaſier to judge of the falſe *Intervals*, and of what Concern they are to *Harmony*.

Table

Table *of true* Diatonic *Intervals within* Diapaſon, *with the Differences between them.*

			Their Rations.	Their Differences.
Hemitone Major.			16 to 15	
Tone Minor.			10 to 9	25 to 24
Tone Major.			9 to 8	81 to 80
3d *Minor*,	Compounded of	*Tone Maj.* & *Hemit. Maj.*	6 to 5	16 to 15
3d *Major*,		*Tone Maj.* & *Tone Min.*	5 to 4	25 to 24
4th.		3d *minor* & *Tone min.* or 3d *major* & *Hemitone major.*	4 to 3	10 to 9
5th.		4th, and *Tone major*; or of the two 3ds.	3 to 2	9 to 8
6th *Minor*;		5th, and *Hemit. maj.* or 4th, and 3d *min.*	8 to 5	16 to 15
6th *Major*;		5th, and *Tone minor* or 4th and 3d *maj.*	5 to 3	25 to 24
7th *Minor*;		6th *maj.* & *Hem. max.* or 6th *min.* & *Tone major*; or 5th and 3d *minor.*	9 to 5	27 to 25
7th *Major*;		6th *maj.* & *Tone maj.* or 5th, and 3d *maj.*	15 to 8	25 to 24
Diapaſon;		7th, and 2d or 6th, & 3d or 5th, & 4th.	2 to 1	16 to 15
Tritone;		3d *maj.* and *Tone maj.*	45 to 32	2048 to 2025
Semidiapente;		4th, and *Hemit. major.*	64 to 45	

Thoſe which ariſe from the Differences of Conſonant Intervals, are call'd *Intervalla Concinna*, and properly appertain to Harmony: The reſt are neceſſary to be known, for making and underſtanding the Scales of Muſick.

Table

Table *of falſe* Diatonic *Intervals, cauſed by Improper Degrees; with their Rations and Differences from the true Intervals.*

This Mark + ſtands for *more*; — for *leſs*.

			Rations.	Differences from true.
Tribemitone	Leaſt;	*Tone minor*, and *Hemit. major.*	32 to 27	81 to 80 —
	Greateſt;	*Tone major*, and *Hemit. max.*	243 to 200	81 to 80 +
Ditone	Leaſt;	2 *Tones minor.*	100 to 81	81 to 80 —
	Greateſt;	2 *Tones major.*	81 to 64	81 to 80 +
Fourth	Leſs;	2 *Tones minor*, & *Hemit. major.*	320 to 243	81 to 80 —
	Greater;	2 *Tones maj.* & *Hemit. maj.*	27 to 20	81 to 80 +
Fifth	Leſs;	Leſs 4th, and *Tone major.*	40 to 27	81 to 80 —
	Greater;	Greater 4th, and *Tone maj.*	243 to 160	81 to 80 +
Sixth	Leaſt;	5th, and *Hemit. minor.*	25 to 16	81 to 80 —
	Greateſt;	5th, and *Tone major.*	27 to 16	81 to 80 +
Seventh	Leaſt;	6th *major*, and *Hemit. major.*	16 to 9	81 to 80 —
	Greateſt;	6th *minor*, and 3d *minor.*	48 to 25	128 to 125 +

Here

HERE in this Account may be seen, how frequently the *Comma*, and the *Diesis*, Abounding or Deficient, by reason of Misplaced Degrees, occasion Discord in *Harmonic Intervals*.

THE *Comma*, by reason of a wrong *Tone*, *i. e.* too much, when a *Tone Major* happens where there ought to be a *Tone Minor*; or too little, when the *Tone Minor* is placed instead of the *Major*. And the *Diesis* is Redundant, or Deficient, by reason of a wrong *Hemitone*; when the *Major* happens instead of the *Minor*, or the contrary: the *Diesis* being the Difference between them. And if *Hemitonium Maximum* get in the Place of *Hemitonium Majus*, the Excess will be a *Comma*; if in the Place of *Hemitone Minor*, the Excess will be *Comma* and *Diesis*.

AND these Anomalies are not Imaginary, or only Possible, but are Real in an Instrument fix'd in Tune by *Hemitones*; as, *Organ*, *Harpsichord*, &c. And the Reader may find some of 'em amongst those four Scales of *Diapason*; in the Sixth Chapter; to which also more may be added: Out of the First of which, I have selected some Examples, using the common Marks, as before, *viz.* + for *more*; and — for *less* or *wanting*.

From
- ♯C, to *b*E; { *Tone Major,* + *Dieſis*; or, 3d *Min.* — *Hemit. Min.*
- ♯C, to F; { 3d *Major,* + *Dieſis*; or, 4th, — *Hemit. Minor.*
- D, to G; 4th, + *Comma.*
- *b*E, to ♯F; { 3d *Min.*—*Dieſ.*& *Com.* or *Tone Min.* + *Hem. Min.*
- *b*E, to ♯G; { 4th, — *Dieſis*; or, 3d *Maj.* + *Hemit. Min.*
- ♯F, to *b*B; { 3d *Maj.* + *Dieſ.*& *Com.* or 4th, — *Hem. Subminim.*
- ♯F, to B; 4th, + *Comma.*
- ♯G, to *b*B: { *Tone Maj.* + *Dieſis*; or, 3d *Min.* — *Hemit. Min.*
- ♯G, to C; { 3d *Major* + *Dieſis*; or, 4th, — *Hemit. Minor.*
- B, to D; 3d *Min.* — *Comma.*

NEXT, take account of ſome Differences which conſtitute ſeveral *Hemitones.*

Dif-

Difference between

- *Tone Major*, and *Hemit. Minor.* } *Hemit. Maxim.* 27 to 25.
- 3d *Major*, and 4th. *Hemit. Majus*, 16 to 15.
- *Tone Major*, and *Hemit. Major.* { *Hemitone Medium* } 135 to 128.
- 3d *Minor*, and 3d *Maj.* { *Hem. Min. Diesis Chromat.* } 25 to 24
- 2 *Tones Major*, and 4th { *Hemiton.* (or *Limma*) *Pythagor.* } 256 to 243.
- *Tone Maj.* and *Limma*, { *Apotome*, 2187 to 2048; or *Hemit. Med.* with *Comma.*

To which may be added out of *Merſennus*,

Differ. between

- *Hemit. Maxim.* and *Hemit. Minor.* { *Hemitonium Minimum.* } 648 to 625.
- *Tone Minor*, and *Hemitone Maxim.* or, *Hemitone Minor*, and *Comma.* { *Hemitonium. Subminimum.* } 250 to 243.

NEXT, take a farther View of *Differences*, moſt of which ariſe out of the preceeding *Differences*, by which you will better ſee how all Intervals are Compounded and Differenced, and more eaſily judge of their Meaſures.

Table of more *Differences*.

Difference between

Tone Maj. and *Tone Min.*	*Comma.*
Tone Maj. and *Hem. Greateſt.*	*Hemitone Minor.*
Tone Maj. and *Hem. Medium.*	*Hemitone Major.*
Tone Maj. and *Hem. Pythag.*	*Apotome.*
Hem. Greateſt, and *Hem. Maj.*	*Comma.*
Hem. Greateſt, & *Hem. Min.*	*Comma*, and *Dieſis*; viz. *Hem. Minimum.*
Hemit. Major, and *Minor.*	*Dieſis.*
Hemit. Major, and *Medium.*	2048 to 2025, viz. *Comma Minus.*
Hemit. Major, and *Pythag.*	*Comma*
Apotome, and *Hemit. Majus.*	Differ. betw. *Comma Majus*, and *Min.*
Apotome, and *Hemit. Med.*	*Comma.*
Apotome, and *Hemit. Pythag.*	*Comma*, and the aforeſaid Difference.
Apotome, and *Hemit. Minus.*	2 *Comma's.*
Hemit. Medium, and *Pythag.*	Differ. of *Comma Majus*, and *Minus.*
Hemit. Medium, and *Minus.*	*Comma.*
Hemit. Pythag. and *Minus.*	*Comma Minus.*
Hemit. Minus, and *Dieſis.*	Somewhat more than 3125 to *Comma*, viz. 3072.
Hemit. Minus, and *Comma.*	*Hem. Subminimum.*
Dieſis, and *Comma.*	*Comma Minus*, viz. 2048 to 2025.
Com. Majus, and *Com. Minus.*	32803 to 32768.

THESE

THESE *Differences* (with ſome more) are found between ſeveral other Intervals; of which more Tables might be drawn, but I ſhall not trouble the Reader with them. Having here ſhewn what they are, he may (if he pleaſe) exerciſe himſelf to examine Theſe by Numbers, and alſo find out Them; and to ſome it may be pleaſant and delightful: And, for that Reaſon, I have the more largely inſiſted on this part of my Subject, which concerns the *Meaſures*, *Habitudes*, and *Differences* of Harmonic Intervals.

I ſhall add one Table more, of the Parts of which theſe leſſer Intervals are compounded; which will ſtill give more Light to the former; and is, in *Effect*, the ſame.

Tone Major contains, & is compounded of { *Tone Minor*, and *Comma*. = *Hemitone Maxim.* and *Hemitone Min.* ; *Hemitone Maj.* = *Limma*, 2 *Hem. Min.* + 1 *Diesis.* + 1 *Comma.* ; *Hemitone Med.* = *Apotome* 1 *Hem. Min.* + 1 *Comma.*

Tone Min. { *Hem. Maxim.* + *Hem. Submin.* = *Hemit. Major*, 2 *Hemit. Min.* + 1 *Diesis.* ; *Hem. Submin.* = *Hemit. Minor.*

Hem. Max. { *Hem. Maj.* + *Comma* = *Hem. Med.* + *Diesis.* = *Hem. Pyth.* + 2 *Comma's* = *Hemit. Min.* + *Dies.* & *Com.*

Hem. Maj. { *Hem. Med.* + *Com. Min.* = *Hem. Pyth.* + *Comma.* = *Hem. Min.* + *Diesis..* = *Hem. Subm.* + *Dies.* & *Com.*

Hem. Med. { *Hem. Min.* + *Comma.* = *Hemitone Pythagoricum.* Difference between *Comma Majus*, and *Minus*, viz. 32805 to 32768.

Hem. Pyth. { *Hemitone Minus.* + *Comma Minus.*

Hem. Min. { *Hemit. Submin.* + *Comma.* = *Diesis*, and 3125 to 3072.

Diesis. { *Comma*, + *Comma Minus.*

Comma. { *Comma Minus.* 32805 to 32768.

I think there ſcarce needs an Apology for ſome of theſe Appellations, in reſpect of Grammar. That I call *Hemitonium*, and *Hexachordon*, *Majus* and *Minus*; ſometimes *Hemitone*, and *Hexachord*, *major*, and *minor*. Theſe two laſt Words are ſo well adapted to our Language, that there's no *Engliſh-man* but knows them. Therefore when I make *Hemitone* an *Engliſh* Word, I take *major* and *minor* to be ſo too, and fitteſt to be join'd with it, without reſpect of *Gender*.

CHAP.

CHAP. IX.

Concluſion.

TO conclude all. Bodies by Motion make Sound; Sound, of fitly-conſtituted Bodies, makes Tune: Tune, by Swiftneſs of Motion is render'd more acute; by Slowneſs more grave: in proportion to the Meaſure of Courſes and Recourſes, of Tremblings or Vibrations of Sonorous Bodies. Thoſe Proportions are found out by the Quantity and Affections of Sounding Bodies; *ex. gr.* by the Length of Chords. If the Proportion of Length *(cæteris paribus)* and conſequently of Vibrations of ſeveral Chords, be commenſurate within the Number *6*; then thoſe Intervals of Tune are Conſonant, and make Concord, the Motions mixing and uniting as they paſs: If incommenſurate, they make Diſcord by the jarring and claſhing of the Motions. Concords are within a limited Number, Diſcords innumerable. But of them, thoſe only here conſider'd, which are (as the *Greeks* term'd them) ἐμμελῆ, *Concinnous*, apt and uſeful in Harmony: Or which, at leaſt, are neceſſary to be known, as being

the Differences and Meaſures of the other; and helping to diſcover the Reaſon of Anomalies, found in the Degrees of Inſtruments tuned by *Hemitones*.

ALL theſe I have endeavour'd to explain, with the manifeſt Reaſons of Conſonancy and Diſſonancy (the Properties of a *Pendulum* giving much Light to it) ſo as to render them eaſie to be underſtood by almoſt all ſorts of Readers; and to that end have enlarg'd, and repeated, where I might (to the more intelligent Reader) have compriz'd it very much ſhorter. But I hope the Reader will pardon that, which could not well be avoided, in order to a full and clear Explanation of that, which was my Deſign, *viz.* the Phloſophy of the Natural Grounds of Harmony.

UPON the whole, you ſee how Rationally, and Naturally, all the Simple Concords, and the two Tones, are found and demonſtrated, by Subdiviſions of *Diapaſon*.

2 to 1, *i.e.* 4 to 2; into 4 to 3, and 3 to 2.
2 to 1, *i.e.* 6 to 3; into 6 to 5, and 5 to 3.
2 to 1, *i.e.* 8 to 4; into 8 to 5, and 5 to 4.
2 to 1, *i.e.* 10 to 5; into 10 to 9, 9 to 8, and 8 to 5.

IN

In which are the Rations (in Radical, or Leaſt Numbers) of the Octave, Fifth, Fourth, Third *Major*, Third *Minor*, Sixth *Major*, Sixth *Minor*, and Tone *Major*, and Tone *Minor*.

And then, all the *Hemitones*, and *Dieſis*, and *Comma*, are found by the Differences of theſe, and of one another; as hath been ſhewn at large.

Now, certainly, this is much to be preferr'd before any Irrational Contrivance of expreſſing the ſeveral Intervals. The *Ariſtoxenian* Way of dividing a *Tone* [*Major*] into twelve Parts, of which 3 made a *Dieſis*, 6 made *Hemitone*, 30 made *Diateſſaron*, (as hath been ſaid) might be uſeful, as being eaſier for Apprehenſion of the Intervals belonging to the three Kinds of Muſick; and might ſerve for a leaſt common Meaſure of all Intervals (like Mr. *Mercator*'s artificial *Comma*) 72 of them being contain'd in *Diapaſon*.

But this Way, and ſome other Methods of dividing Intervals equally, by *Surd Numbers* and *Fractions*, attempted by ſome modern Authors; could never conſtitute true Intervals upon the Strings of an Inſtrument, nor

nor afford any Reaſon for the Cauſes of Harmony, as is done by the Rational Way, explaining Conſonancy by united Motions, and Coincidence of Vibrations. And tho' they ſuppos'd ſuch Diviſions of Intervals; yet we may well believe, that they could not make them, nor apply 'em in tuning a Muſical Inſtrument; and if they could, the Intervals would not be true, nor exact. But yet, the Voice offering at thoſe, might more eaſily fall into the true Natural Intervals. *Ex. gr.* The Voice could hardly expreſs the ancient *Ditone* of two *Tones Major*; but, aiming at it, would readily fall into the Rational Conſonant *Ditone* of 5 to 4, conſiſting of *Tone Major* and *Tone Minor*. It may well be rejected as unreaſonable, to meaſure Intervals by Irrational Numbers, when we can ſo eaſily diſcover and aſſign their true Rations in Numbers, that are minute enough, and eaſie to be underſtood.

I did not intend to meddle with the Artificial Part of Muſick: The Art of Compoſing, and the Metric and Rhythmical Parts, which give the infinite Variety of Air and Humour, and indeed the very Life to Harmony; and which can make *Muſick*, without Intervals of Acuteneſs and Gravity, even upon a Drum; and by which chiefly

chiefly the wonderful Effects of Muſick are perform'd, and the Kinds of Air diſtinguiſh'd; as, *Almand*, *Corant*, *Jigg*, &c. which variouſly attack the Fancy of the Hearers; ſome with Sprightfulneſs, ſome with Sadneſs, and others a middle Way: Which is alſo improv'd by the Differences of thoſe we call Flat, or Sharp Keys; the Sharp, which take the Greater Intervals within *Diapaſon*, as Thirds, Sixths, and Sevenths *Major*; are more brisk and airy; and being aſſiſted with Choice of Meaſures laſt ſpoken of, do dilate the Spirits, and rouze 'em up to Gallantry and Magnanimity. The Flat, conſiſting of all the leſs Intervals, contract and damp the Spirits, and produce Sadneſs and Melancholy. Laſtly, a mixture of theſe, with a ſuitable *Rhythmus*, gently fix the Spirits, and compoſe them in a middle Way: Wherefore the Firſt of theſe is call'd by the Greeks *Diaſtaltic*, Dilating; the Second, *Syſtaltic*, Contracting; the Laſt, *Heſychiaſtic*, Appeaſing.

I have done what I deſign'd, ſearch'd into the Natural Reaſons and Grounds, the Materials of Harmony; not pretending to teach the Art and Skill of Muſick, but to diſcover to the Reader the Foundations of it, and the Reaſons of the

Anc-

Anomalous Phænomena, which occur in the Scales of Degrees and Intervals; which tho' it be enough to my Purpoſe, yet is but a ſmall (tho' indeed the moſt certain, and, conſequently, moſt delightful) Part of the Philoſophy of Muſick; in which there remain infinite curious Diſquiſitions, that may be made about it; as, what it is that makes Humane Voices, even of the ſame Pitch, ſo much to differ one from another? (For tho' the Differences of Humane Countenances are viſible, yet we cannot ſee the Differences of Inſtruments of Voice, nor conſequently of the Motions and Colliſions of Air, by which the Sound is made.) What it is that conſtitutes the different Sounds of the Sorts of Muſical Inſtruments, and even ſingle Inſtruments? How the Trumpet, only by the Impulſe of Breath, falls into ſuch Variety of Notes, and in the Lower Scale makes ſuch Natural Leaps into Conſonant Intervals of Third, Fourth, Fifth, and Eighth. But this, I find, is very ingeniouſly explicated by an honourable Member of the *R. S.* and publiſh'd in the *Philoſophical Tranſactions*, N° 195. Alſo how the *Tube-Marine*, or Sea-Trumpet (a *Monochord*) ſo fully expreſſeth the Trumpet; and is alſo made to render other Varieties of Sounds; as, of a Violin,

lin, and Flageolet, whereof I have been an Ear-witneſs? How the Sounds of Harmony are receiv'd by the Ear; and why ſome Perſons do not love Muſick? *&c.*

As to this laſt; the incomparable Dr. *Willis* mentions a certain Nerve in the Brain, which ſome Perſons have, and ſome have not. But further, it may be conſider'd, that all Nerves are compoſed of ſmall Fibres; Of ſuch in the Guts of Sheep, Cats, *&c.* are made Lute-Strings: And of ſuch are all the Nerves, and amongſt them, thoſe of the Ear, compoſed. And, as ſuch, the latter are affected with the regular Tremblings of Harmonic Sounds. If a falſe String (ſuch as I have before deſcrib'd) tranſmit its Sound to the beſt Ear, it diſpleaſeth. Now, if there be found Falſeneſs in thoſe Fibres, of which Strings are made, why not the like in thoſe of the Auditory Nerve in ſome Perſons? And then 'tis no Wonder if ſuch an Ear be not pleas'd with Muſick, whoſe Nerves are not fitted to correſpond with it, in commenſurate Impreſſions and Motions. I gave an Inſtance, in *Chap.* III, how a Bell-Glaſs will tremble and eccho to its own Tune, if you hit upon it: And I may add, That if the Glaſs ſhould be irregu-

irregularly framed, and give an uncertain Tune, it would not answer your Trial. In fine, Bodies must be regularly framed to make Harmonic Sounds, and the Ear regularly constituted to receive them. But this by the by; and only for a Hint of Enquiry.

I was saying, That there remain infinite Curiosities relating to the Nature of Harmony, which may give the most Acute Philosopher Business, more than enough, to find out; and which, perhaps, will not appear so easie to demonstrate and explain, as are the Natural Grounds of *Consonancy* and *Dissonancy*.

After all therefore, and above all, by what is already discover'd, and by what yet remains to be found out; we cannot but see sufficient Cause to rouze up our best Thoughts, to Admire and Adore the Infinite Wisdom and Goodness of Almighty God. His Wisdom, in ordering the Nature of Harmony in so wonderful a manner, that it surpasseth our Understanding to make a through Search into it, tho' (as I said) we find so much by Searching, as does recompense our Pains with Pleasure and Admiration.

And his Goodness, in giving Musick for the Refreshings and Rejoycings of Mankind; so that it ought, even as it relates to Common Use, to be an Instrument of our Great Creator's Praise, as He is the Founder and Donor of it.

But much more, as 'tis advanc'd and ordain'd to relate immediately to his Holy Worship, when we Sing to the Honour and Praise of God. It is so Essential a Part of our Homage to the Divine Majesty, that there was never any Religion in the World, *Pagan*, *Jewish*, *Christian*, or *Mehumetan*, that did not mix some Kind of Musick with their Devotions; and with Divine Hymns, and Instruments of Musick, set forth the Honour of God, and celebrate his Praise. Not only, *Te decet Hymnus Deus in Sion*, (Psal. 65.) but also — *Sing unto the Lord all the whole Earth*, (Psal. 96.)

And it is that which is incessantly perform'd in Heaven, before the Throne of God, by a General Consort of all the Holy Angels and the Blessed.

In short, we are in Duty and Gratitude bound to bless God, for our Delightful *Refresh-*

Refreſhments by the Uſe of Muſick; but eſpecially, in our Publick Devotions, we are oblig'd by our Religion, with Sacred Hymns and Anthems, to magnifie his Holy Name; that we may at laſt find Admittance above, to bear a Part in that Bleſſed Conſort, and eternally Sing *Hallelujahs* and *Triſagions* in Heaven.

Δόξα τῶν Θεῶ.

FINIS.

RULES for Playing

A

THOROW-BASS,

By the late Famous

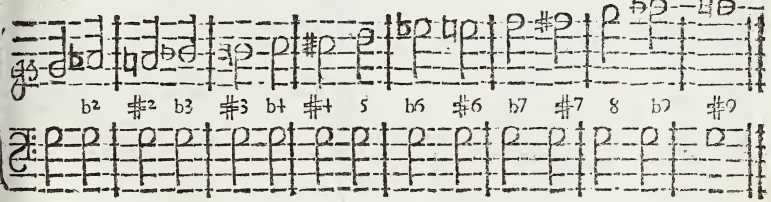
Mr. *Godfry Keller.*

MUSICK consists in *Concords*, and *Discords*; the *Concords* are Four, and of two kinds, *viz.* Perfect and Imperfect; the Perfect are the *5th* and *8th*; the Imperfect the *3d* and *6th*. The *Discords* are Three, *viz.* the *2d*, *4th*, and *7th*; the *9th* being the same with the *2d*, but differently accompany'd.

The *Flat* Imperfect *5th* is used, either as a *Concord* or *Discord*, but most commonly like the latter.

The following Scheme, (the Treble ascending by Semitones) shews all *Concords* and *Discords*, as they stand with regard to the Bass.

By *Chords* is meant either *Concords* or *Discords*; by *Semitones* is meant half Notes.

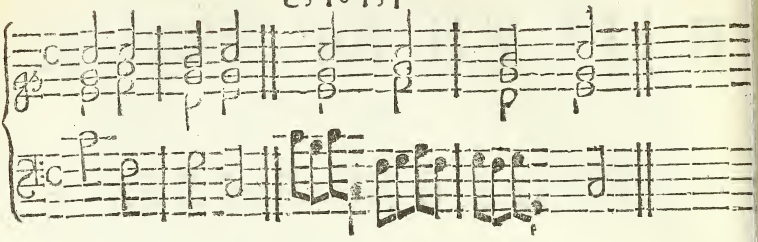


There are other *Chords* us'd sometimes, as the *flat* 5th, &c. but those shall be treated of hereafter.

In common *Chords* which are the *3d*, *5th*, and *8th* avoid the taking two *5ths* or two *8ths*, together, not being allow'd either in Playing or Composition; and the best way to do it in playing, is to move your Hands contrary one to the other.

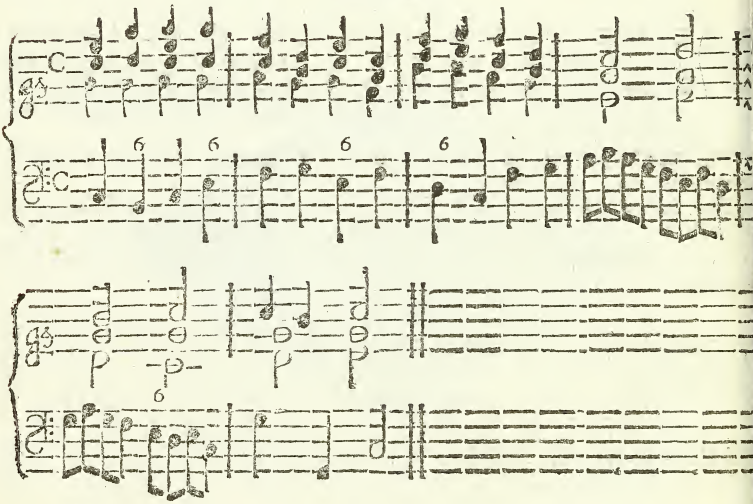
When the first common *Chord* you take is the *3d*, the next must be the *5th* and *8th*, and so *vice versâ*, as the following Scheme will illustrate.

Example of Common Chords differenly taken. $\left\{\begin{matrix}8\\5\\3\end{matrix}\right|\left\|\begin{matrix}5\\3\\8\end{matrix}\right|\left\|\begin{matrix}3\\8\\5\end{matrix}\right|$



The Sixth may be taken with the third and eighth, in full Playing the following ſeveral ways. $\left\{\begin{matrix}6\\3\\6\end{matrix}\right|\left\|\begin{matrix}3\\6\\3\end{matrix}\right|\left\|\begin{matrix}8\\6\\3\end{matrix}\right|\left\|\begin{matrix}3\\6\\8\end{matrix}\right|\left\|\begin{matrix}6\\3\\8\end{matrix}\right.$

Example of Common Chords *and* Sixes, *taken the ſeveral ways above mentioned.*



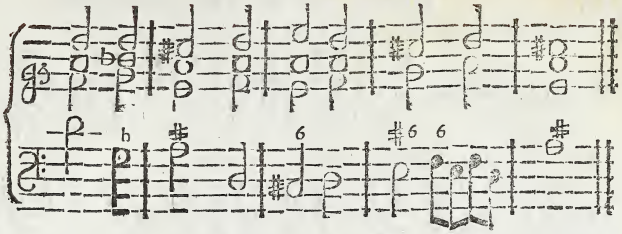
On any Note where nothing is mark'd, common Chords are play'd. In Sixes muſt be obſerv'd that when the *Baſs* is low, and requires a natural *flat* 6th, you muſt play two ſixes and one third; if the *Baſs* is high and requires a natural *flat* 6th, play two thirds and one ſixth; if the 3d or 6th happens to be ſharp inſtead of two ſixes or two thirds

Play $\left\{\begin{matrix}8\\6\\3\end{matrix}\right|\left\|\begin{matrix}3\\8\\6\end{matrix}\right|\left\|\begin{matrix}6\\3\\8\end{matrix}\right|$ Alſo in Diviſions where a ſixth is required, inſtead of two thirds, or two ſixes, play the ſame.

A *flat* or *ſharp* mark'd over or under any Note in the *Baſs*, ſignifies *flat* or *ſharp* third to be play'd: A *flat* or *ſharp* mark'd before a Note or Figure, ſignifies that Note or Figure to be play'd *flat* or *ſharp*.

Exa

Example.



All *Keys* are known to be *flat* or *ſharp*, not by the *flats* or *ſharps* plac'd t the beginning of a Leſſon; but by the third above the *Key*, for if your hird is *Flat*, the *Key* is *Flat*; if your Third is *Sharp*, the *Key* is *Sharp*.

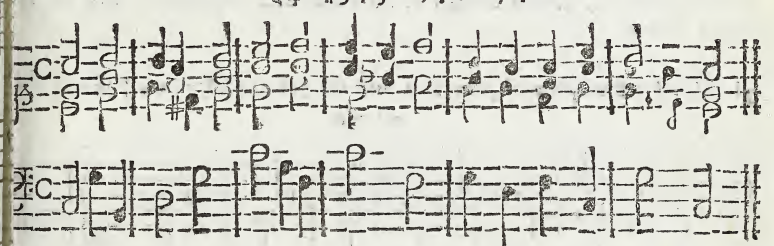
All *ſharp* Notes naturally require *flat* Thirds, all *flat* Notes require *arp* Thirds; the ſame Rule hold as to Sixes.

B, *E*, and *A* are naturally *ſharp* Notes in an open *Key*; *F*, *C*, and *G* re naturally *flat* Notes in an open *Key*.

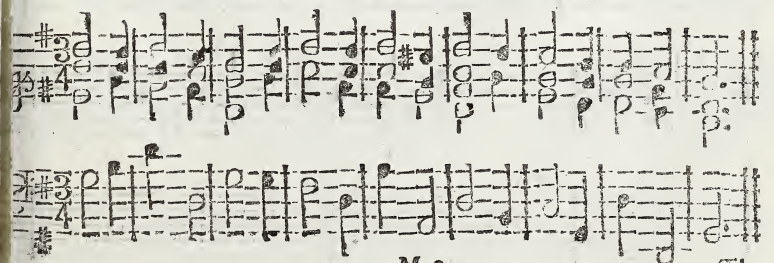
Diſcords are prepared by Concords, and reſolved into Concords, which re brought in when a part lies ſtill, and are ſometimes uſed in contrary lotion.

There are three ſorts of *Cadences*, or full *Cloſes*, as when the *Baſs* falls a th, or riſes a 4th, *viz* the Common *Cadence*; the 6th and 4th *Cadence*; nd the great (or fulleſt) *Cadence*. Each of theſe may be accompany'd different ways; as will be ſeen by the following Examples.

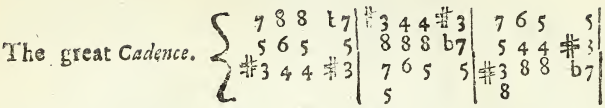
The Common Cadence.

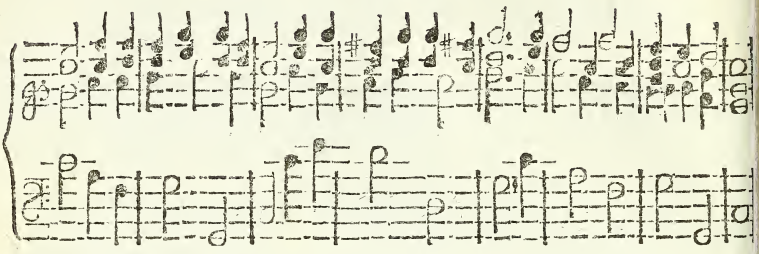


he *6th* and *4th* Cadence.



The great *Cadence.*

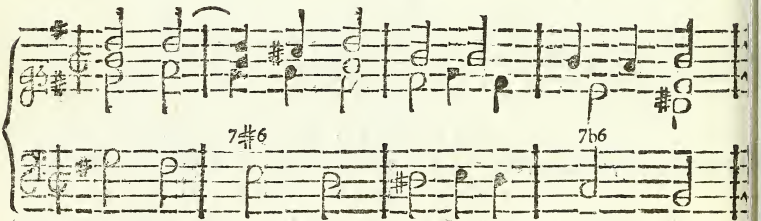


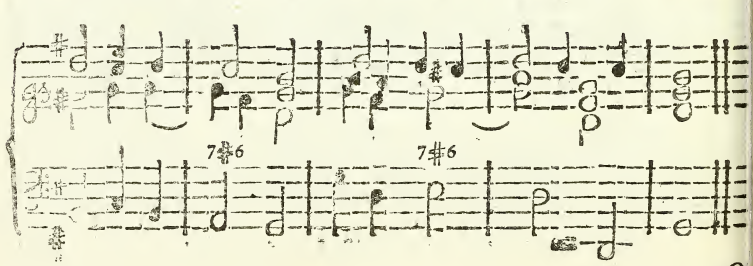


In all Cadences whatſoever, where the *Baſs* riſes a 4th, or falls a 5t Obſerve, that the 4th falls half a Note into a *ſharp* Third, and the 8 a whole Note into a *flat* 7th.

There is another Cadence call'd the 7th and 6th Cadence, which counted but a half Cloſe, and if the 6th is *flat*, is never uſed for a fin Cloſe, becauſe it does not ſatisfy the Ear, like as when the *Baſs* falls 5th, or riſes a 4th, 'tis often introduced in a piece of Muſick, as t Air may require; and when it ends any one part of a Piece, 'tis in ord to begin a new Movement or Subject: The 7th and *ſharp* 6th may be uſ for a final Cloſe, if the Deſign of the Compoſer requires it, but 'tis ve rarely done.

The following Example will ſhew how both the 7th and b6*th, and 7th and* ♯6 *are uſ'd.*





Obſerve when a Diſcord happens in the higher Note, leave the Concord out above it.

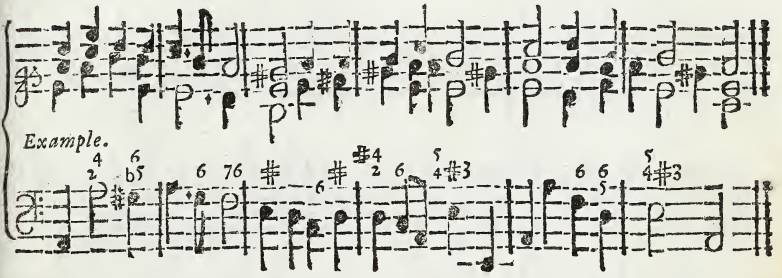
The *Flat* 4*th* and ſecond. 6 4 2 | 2 6 4 | 4 6 2 — here inſtead of the 6*th*, the 5*th* may be added, but then it ought to be mark'd.

The *Sharp* 4*th* and ſecond. 6 ♯4 2 | 2 6 ♯4 | ♯4 2 6

The *Flat* 5*th* and 6*th* join'd. 6 ♭5 3 | ♭3 6 ♭5 | ♭5 3 6 — here the 8*th* is omitted unleſs it be in paſſing Notes.

The perfect 5*th* and 6*th* join'd. 6 5 3 | 3 6 5 | 5 3 6 — here the 8*th* if one think fit to play full may be added.

The perfect fifth when joyn'd with a ſixth is uſed like a Diſcord.



Example.

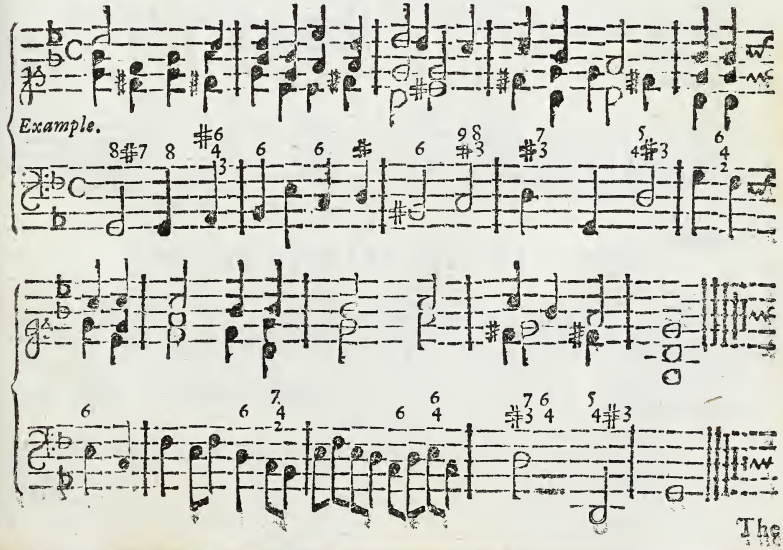
The *Sharp* 7*th*, when the *Baſs* lies ſtill. ♯7 4 2 | 2 ♯7 4 | 4 2 ♯7 — here to play full the *Flat* 6*th* may be added.

When the 3*d* and 4*th* are mark'd above one another. 7 4 3 | 3 7 4 | 4 3 7 — here inſtead of the 7*th Sharp* 6*th* may be uſed, but then it ought to be mark'd.

The 9*th* reſolving into the 8*th*. 3 9 5 | 5 8 3 | 9 5 3 8

The 6*th* and 4*th* when the *Baſs* deſcends by degrees. 6 4 2 | 2 6 4 | 4 2 6

The 6*th* and 4*th* when the *Baſs* ſkips or lies ſtill. 6 4 8 | 8 6 4 | 4 8 6

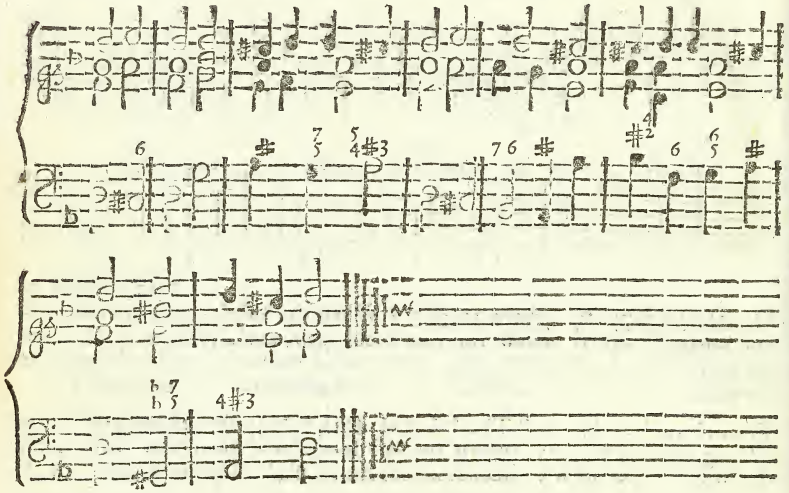


Example.

The *7th* and *5th* happening juſt before the Cadence Note. { 7 3 5 / 5 7 3 / 3 5 7 } here inſtead of the third, the ninth if prepar'd may be uſed but then it ought to be mark'd.

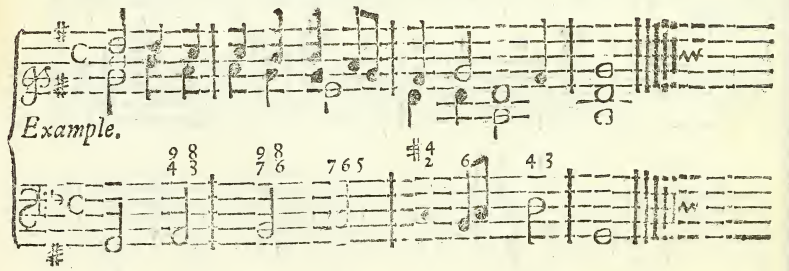
The extreme *Flat* ſeventh and *Flat* fifth happening juſt before the Cadence Note. { b7 3 b5 / b5 b7 3 / 3 b5 b7 } the extreme *Flat* ſeventh is the ſame with the *Sharp* ſixth.

The extreme *Sharp* ſecond and fourth. { 6 ♯2 4 / 4 6 ♯2 / ♯2 4 6 } the extreme *Sharp* ſecond is the ſame diſtance as the *Flat* third. { *Ex.* as follows.



The *4th* and *9th* reſolving into the *3d* and *8th*. { 4 3 / 9 8 / 5 } { 9 8 / 5 / 4 3 / 9 8 }

The *9th* and *7th* reſolving into the *3d* and *8th*. { 9 8 / 7 6 / 3 } { 7 6 / 3 / 9 8 / 7 6 }



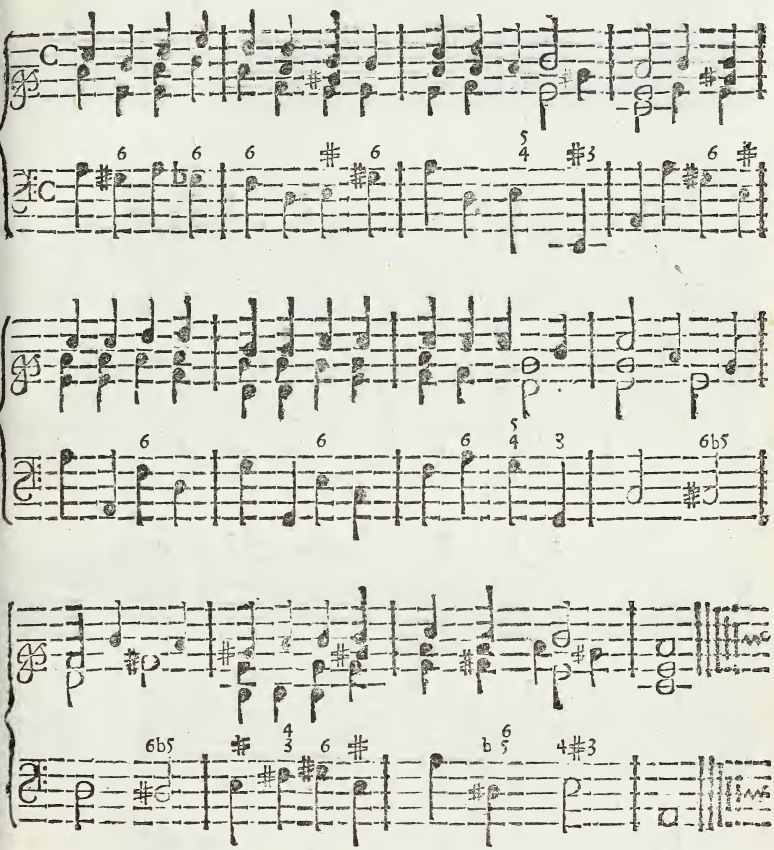
When the *Baſs* aſcends or deſcends one or two Notes, move your Hands in playing contrary one to the other.

After a ſixth where no eighth is concerned, you may either aſcend or deſcend together.

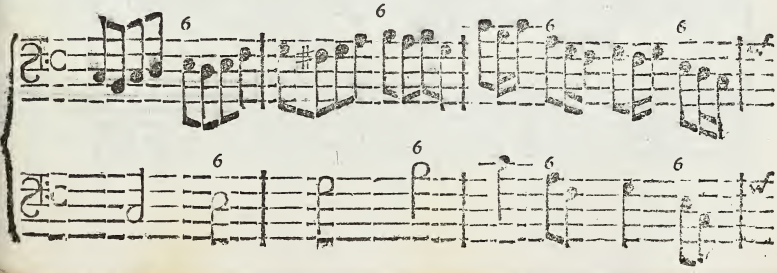
After

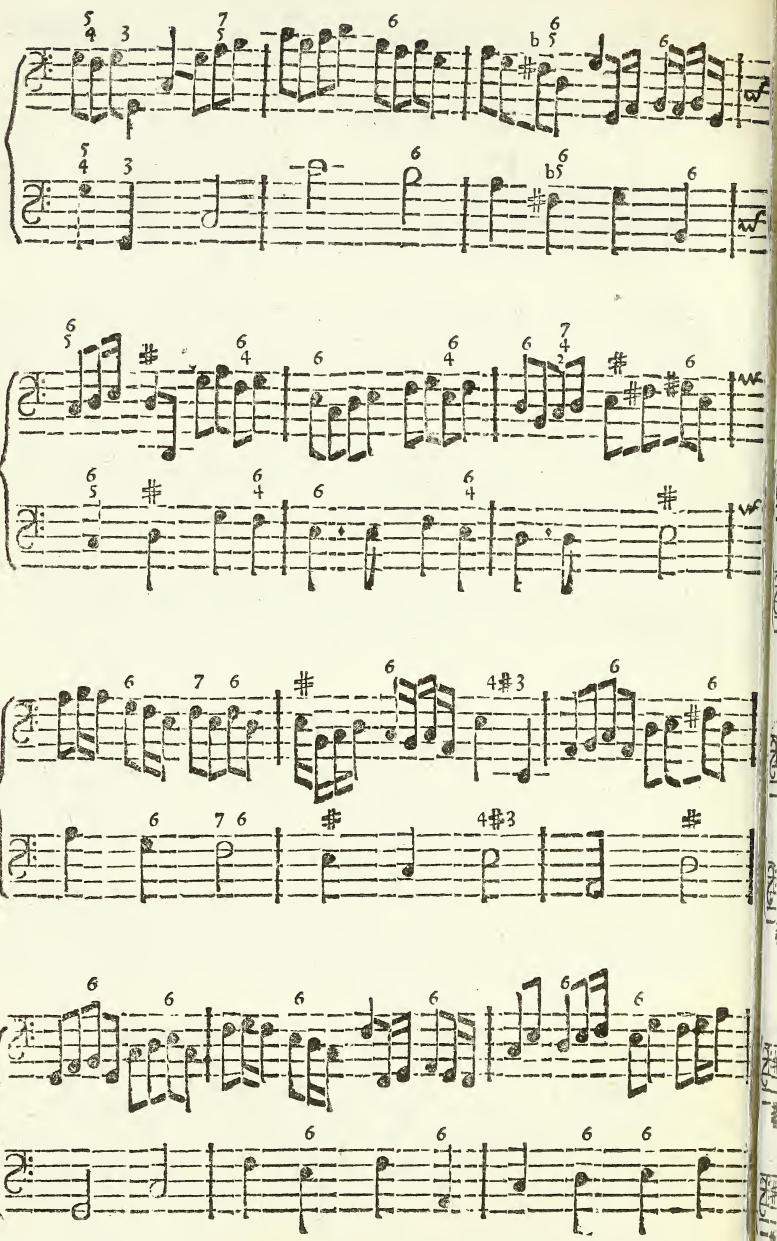
After a ſixth where the eighth lies in the middle, you may either aſcend or deſcend.

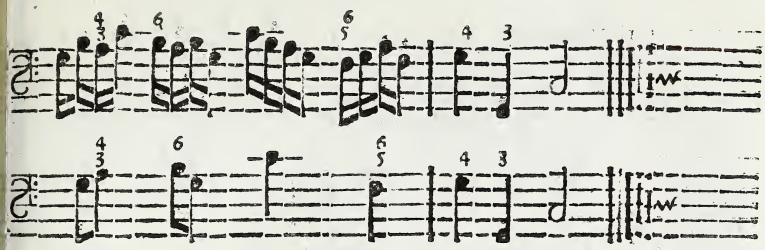
Example.



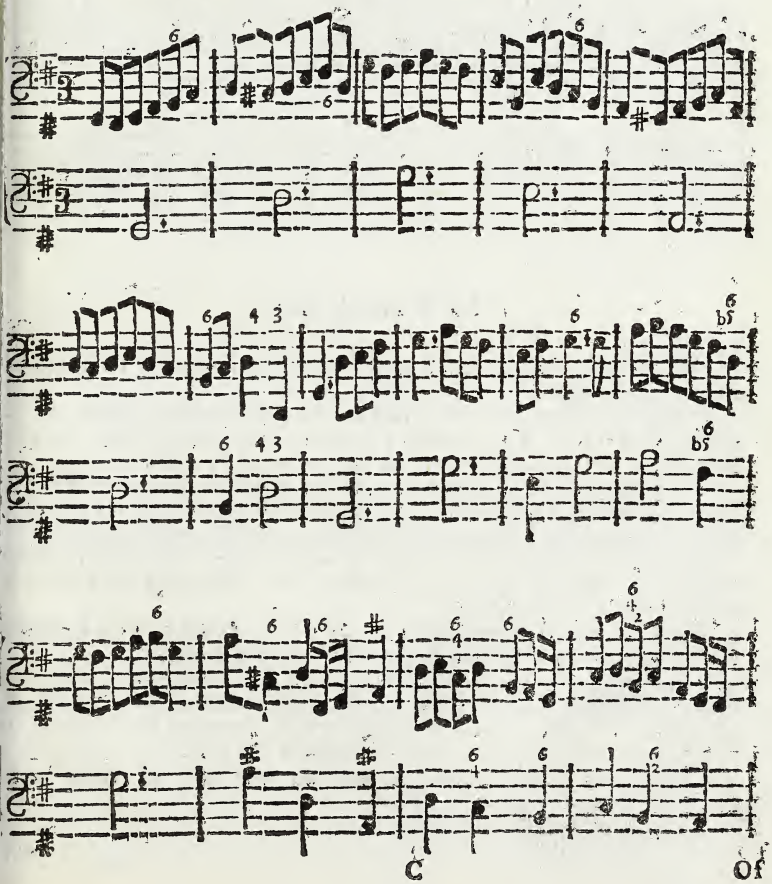
Example of paſſing Notes in Common-time.

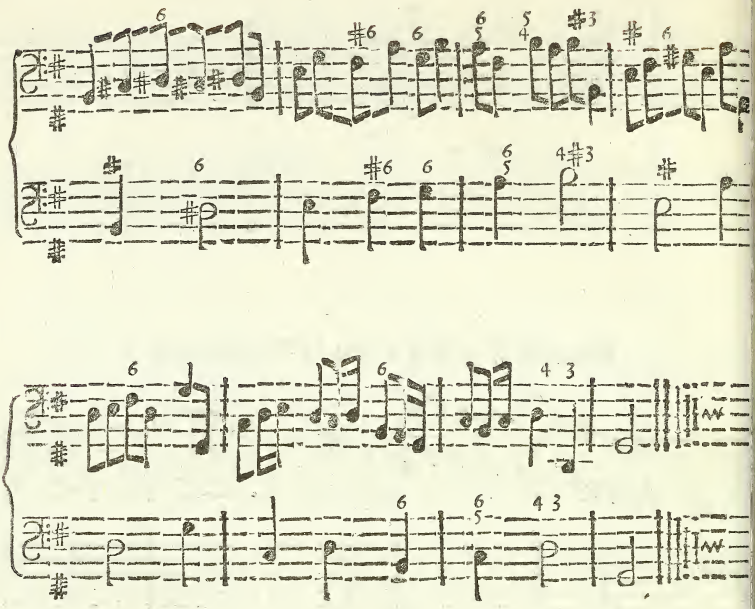






Example of passing Notes in Triple-time.





Of Natural Sixes.

Play common Chords on all Notes where the following Rules dont d
re&t you otherwiſe.

The natural Sixes in a *Sharp* Key are on the half Note below the Ke
the third above the Key, and on all extraordinary *Sharp* Notes out of t
Key, if not to the contrary mark'd, or prevented by Cadences.

The natural Sixes in a *Flat* Key are on the Note below the Key ; t
Note above the Key, and on all extraordinary *Sharp* Notes out of t
Key, if not to the contrary mark'd, or prevented by Cadences.

When the *Baſs* either in a *Flat*, or a *Sharp* Key, aſcends or deſcen
half a Note, Sixes are proper on the firſt Note, falling on the ſecond, u
leſs prevented by a Cadence.

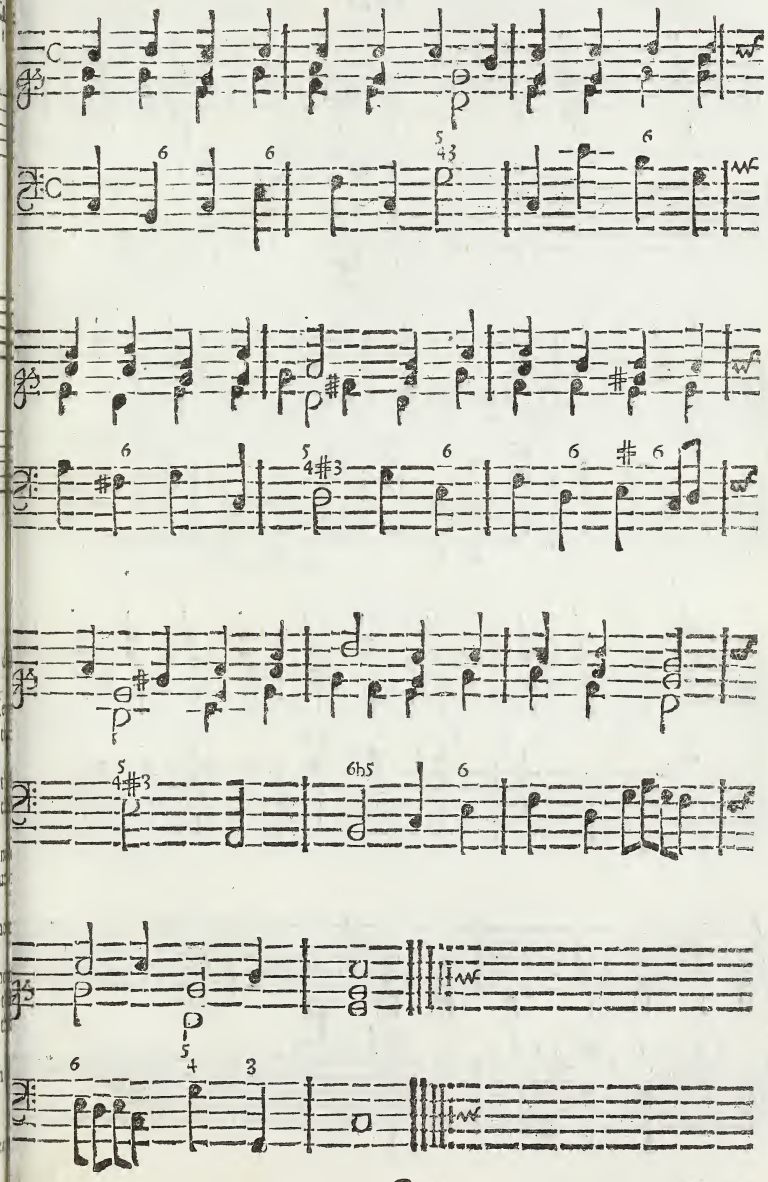
When the *Baſs* either in a *Flat* or *Sharp* Key, deſcends with a comm
Chord by thirds ; Sixes are proper on the falling thirds.

When the *Baſs* either in a *Flat* or a *Sharp* Key, aſcends with a comm
Chord by thirds: Sixes are proper on the riſing thirds. In a *Flat* Key t
third above the Key generally requires a ſixth to prepare the Cadence, t
fifth being repugnant to the half Note below the Key.

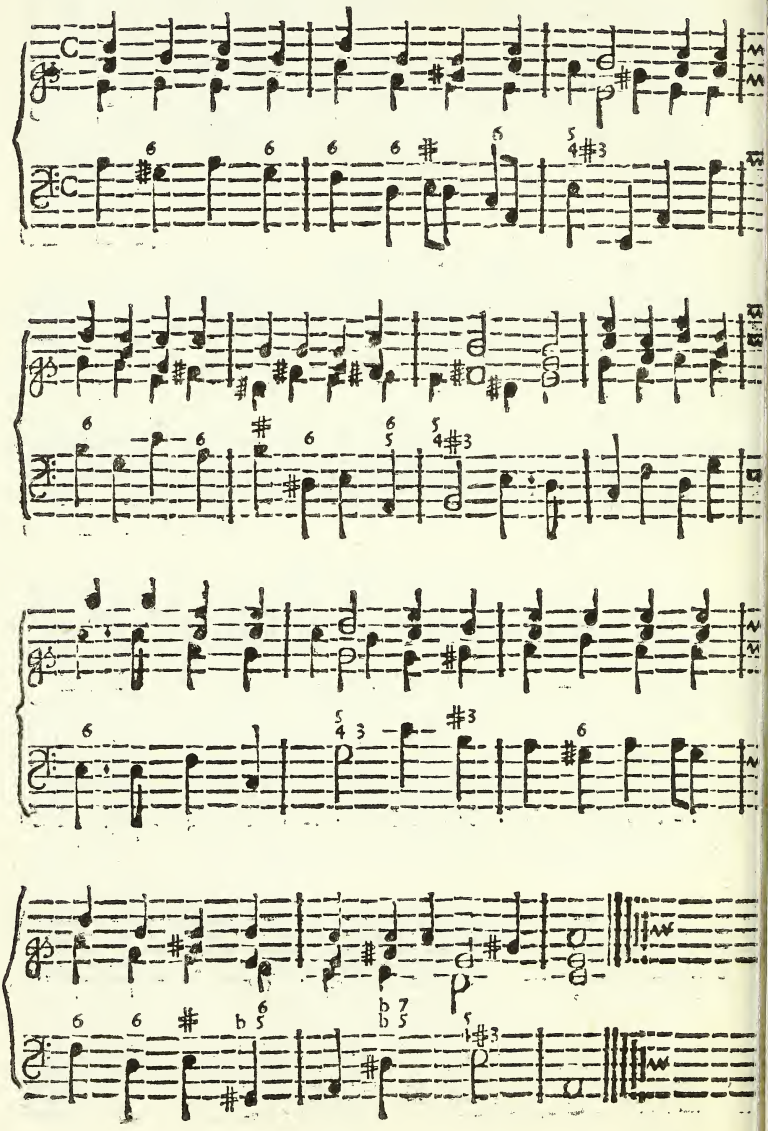
Seldom two Notes aſcend or deſcend but one of them hath
Sixth.

Exa

Example of Natural Sixes *and proper* Cadences *in a ſharp* Key.



Example of Natural Sixes *and proper* Cadences *in a ſa*
Key.



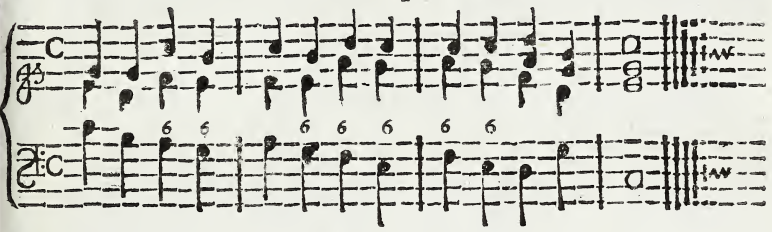
Not

Now all theſe *Sixes* mentioned either in a *Flat* or *Sharp* Key, are not only to be obſerved in the Key you play in, but likewiſe in all other *Cadences* you are going into: And for the time you keep in that *Cadence*, obſerve the Rules for *Sixes* as tho' you were in the Key your Leſſon is Compoſed in.

Where the *Baſs* aſcends a perfect fourth, or deſcends a perfect fifth, *Sixes* are generally left.

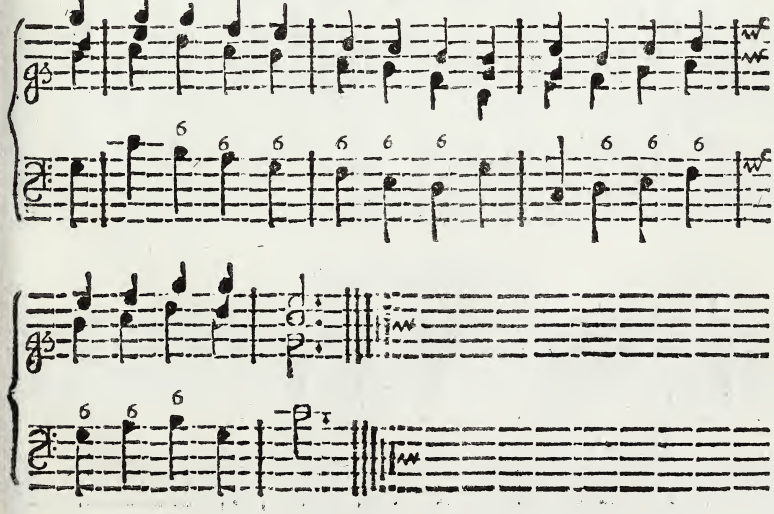
Other Rules for *Sixes* are where the *Baſs* moves by degrees downwards, then theſe *Sixes* may be play'd on every other Note.

Example.



The Compoſer (eſpecially in few parts) may Compoſe as many *Sixes* either aſcending or deſcending by degrees as they think fit, but then they ought to be marked.

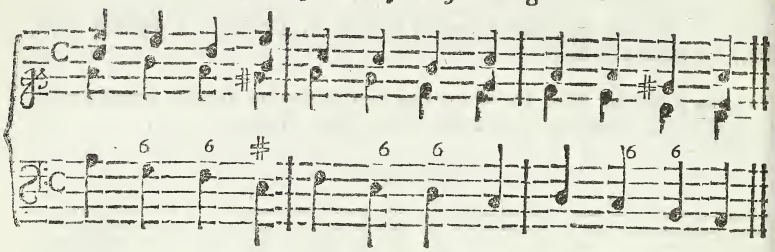
Example.



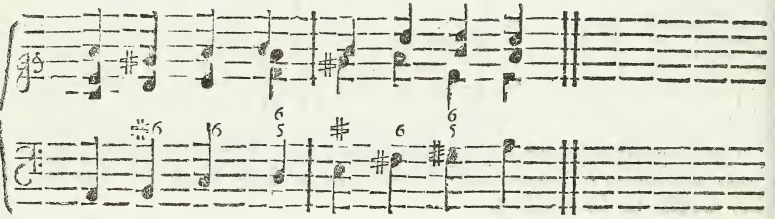
Now

Now here follows an Example where two *Sixes* are absolute necessary, and that descending because they are short *Cadences* instead of 7. 6 mark'd.

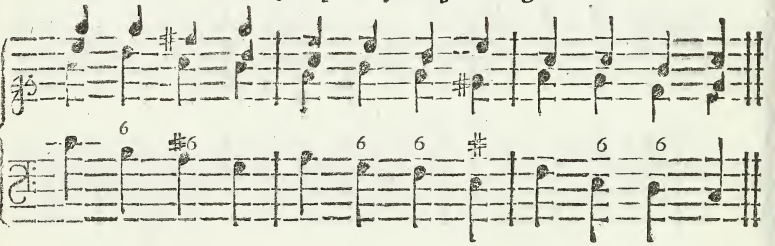
In a flat Key *Descending.*



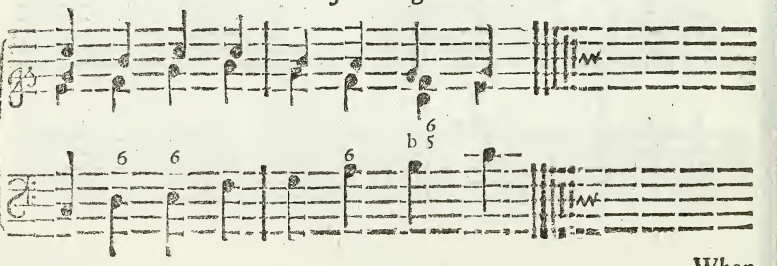
Ascending.



In a sharp Key *Descending.*



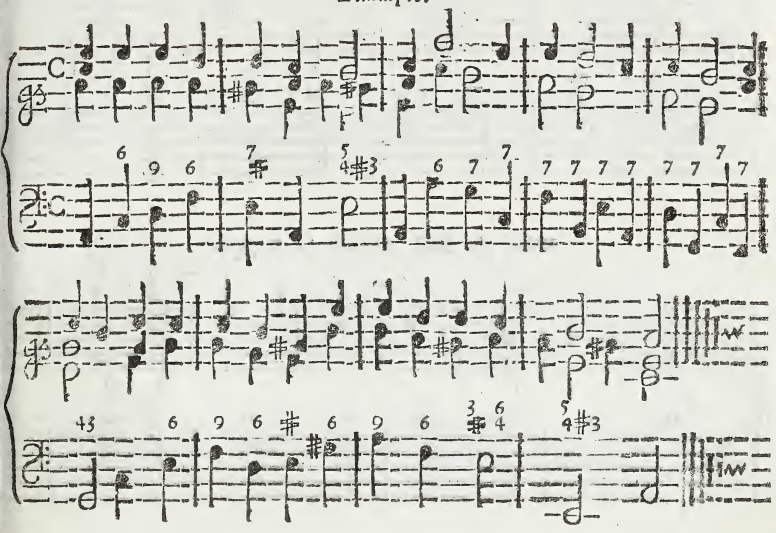
Ascending.



When

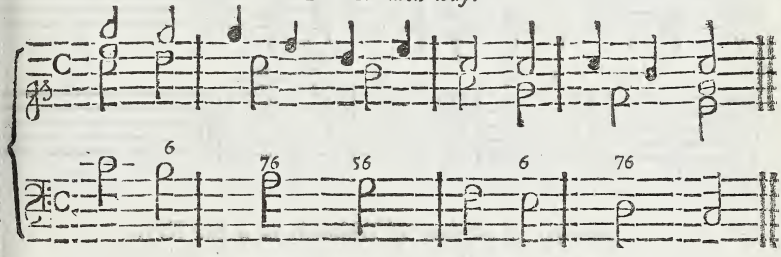
When the Baſs lies ſtill, the Seventh is generally reſolved into the 6th, and the 9th into the 8th. The Example which follows, ſhews how Diſcords may be Reſolved ſeveral ways.

Example.

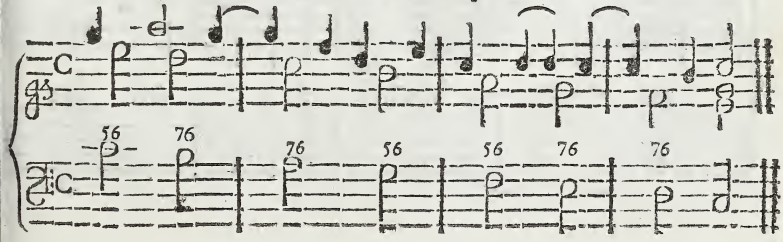


Several Examples of what may be done when the Baſs Deſcends by degrees.

The Common way.

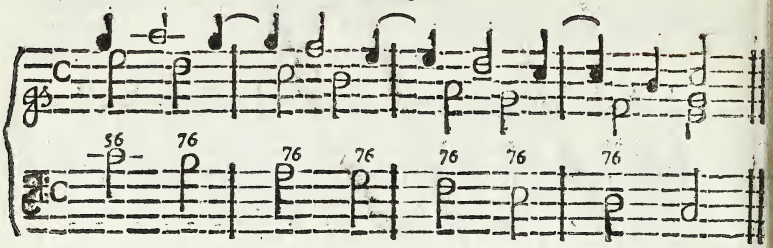


Natural and Artificial.

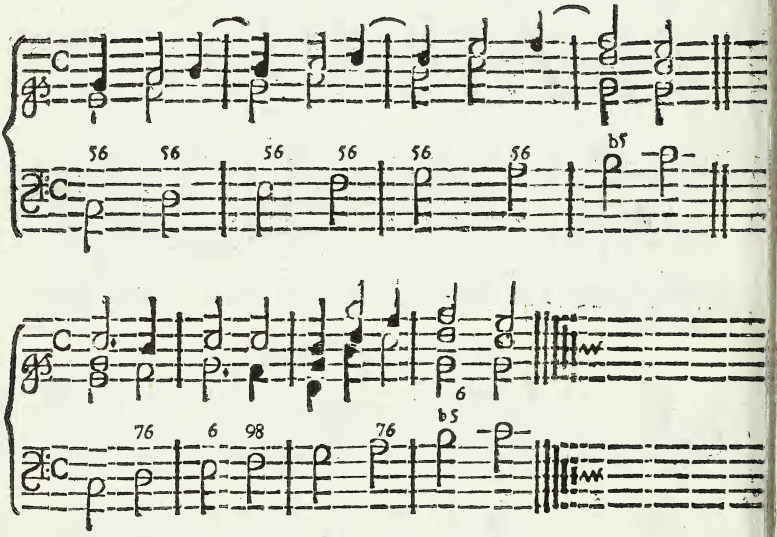


All

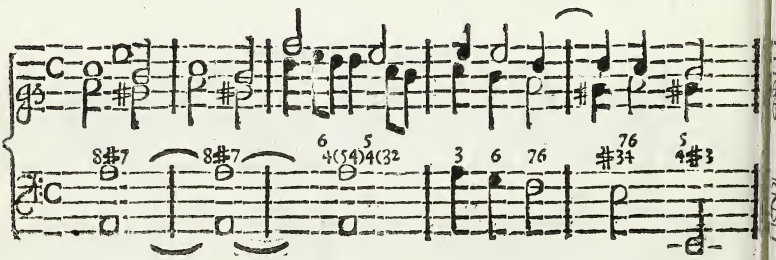
All Artificial.

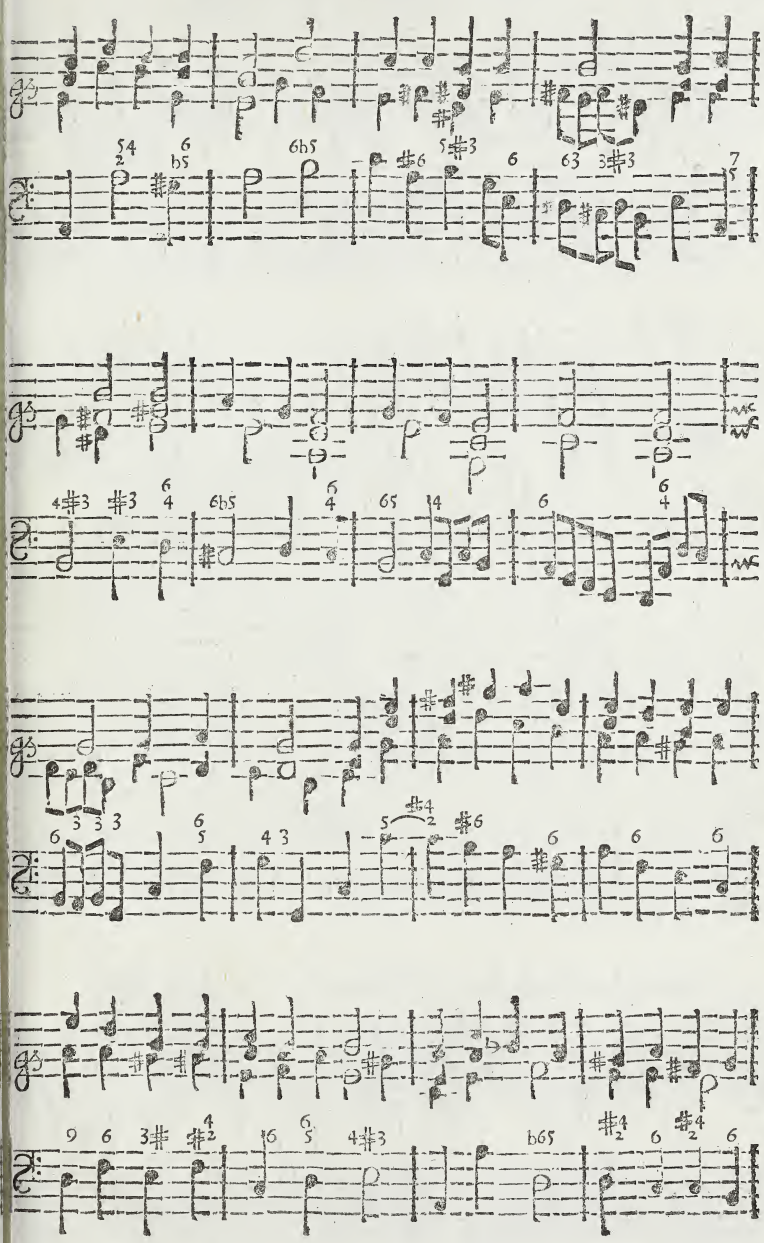


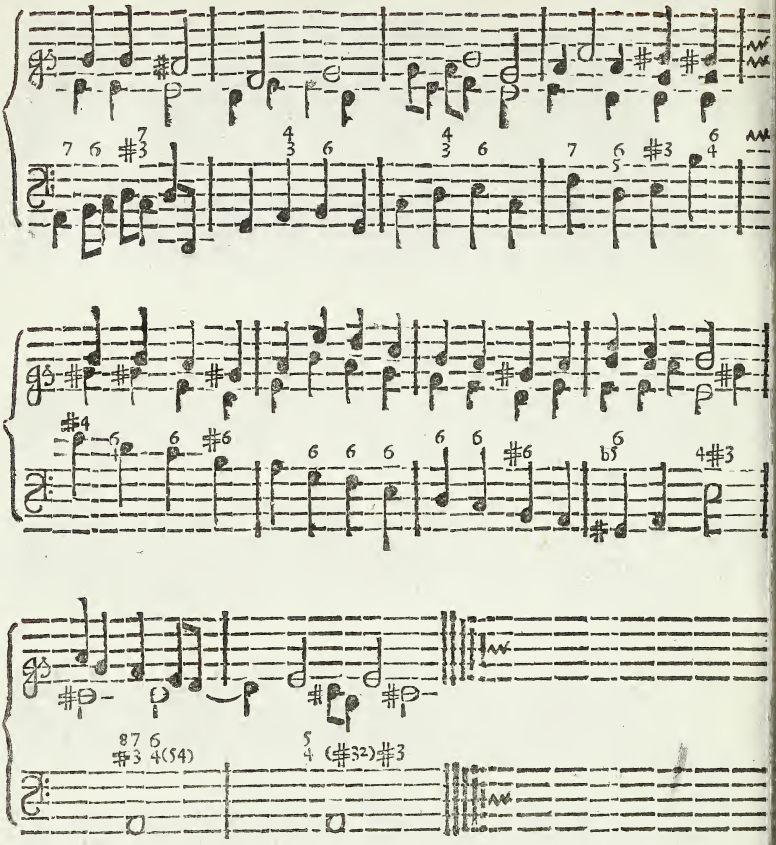
When the Bafs *Aſcends by Degrees.*



Example of all ſorts of Diſcords *in a flat* Key.

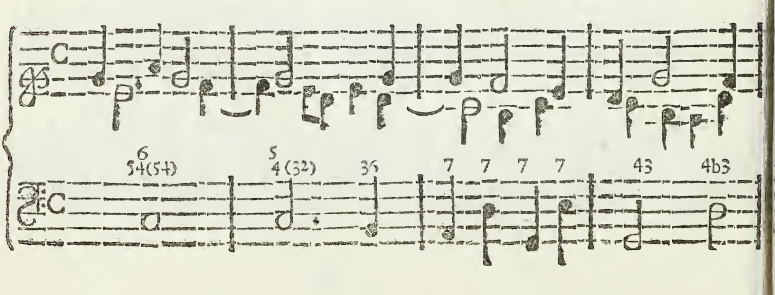


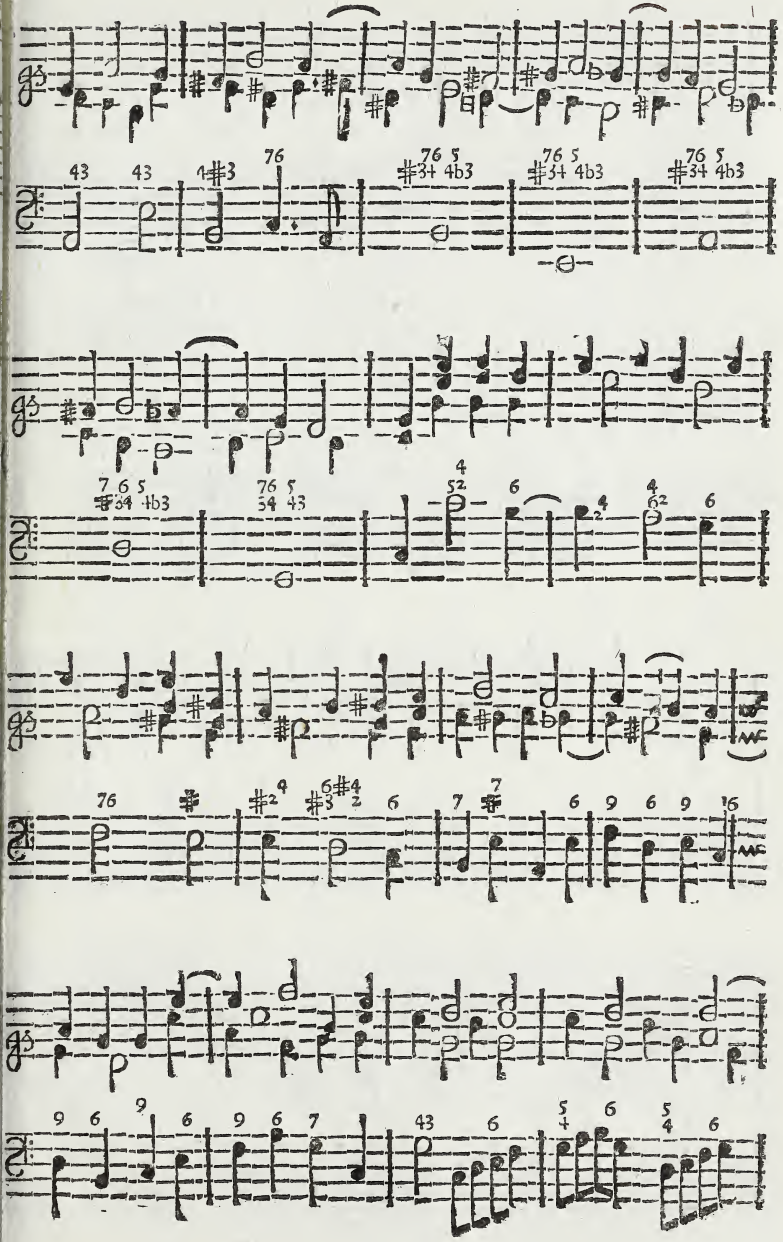


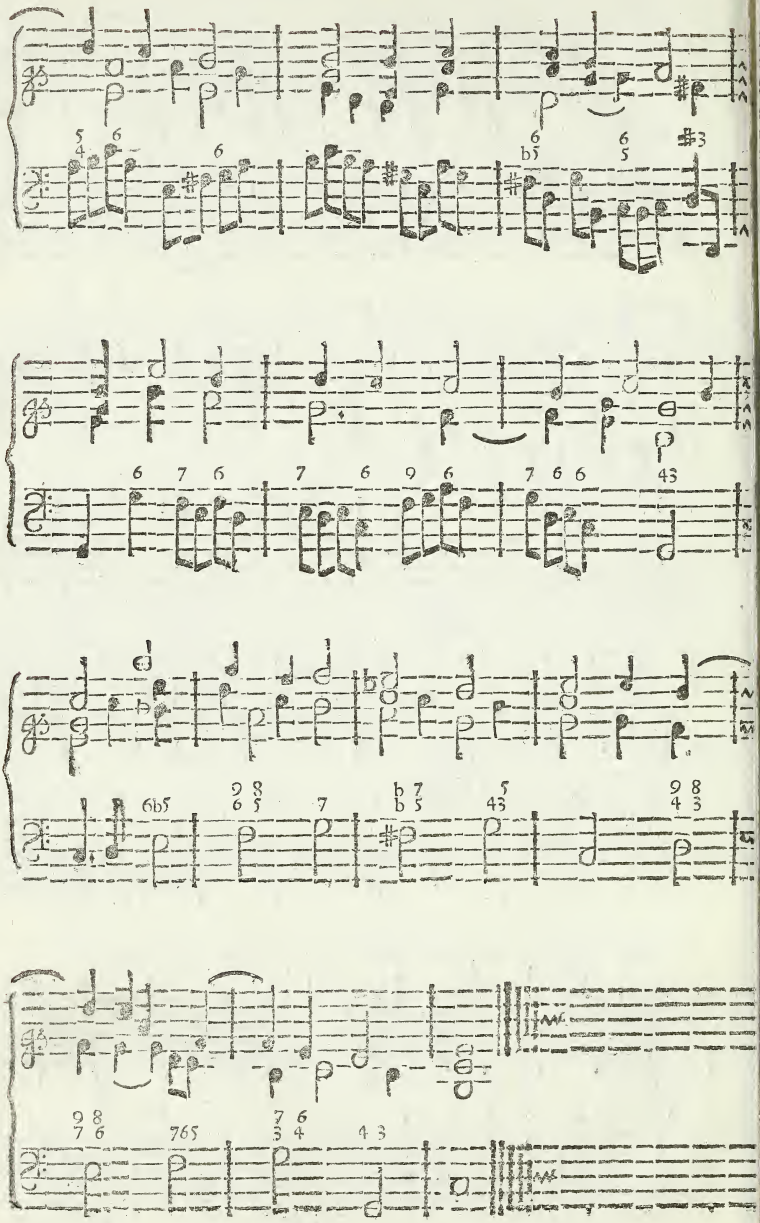


Where the Figures are ſet in Parentheſis, thoſe I wou'd have only drope to ſet off Playing.

Example of all ſorts of Diſcords *in a ſharp* Key.

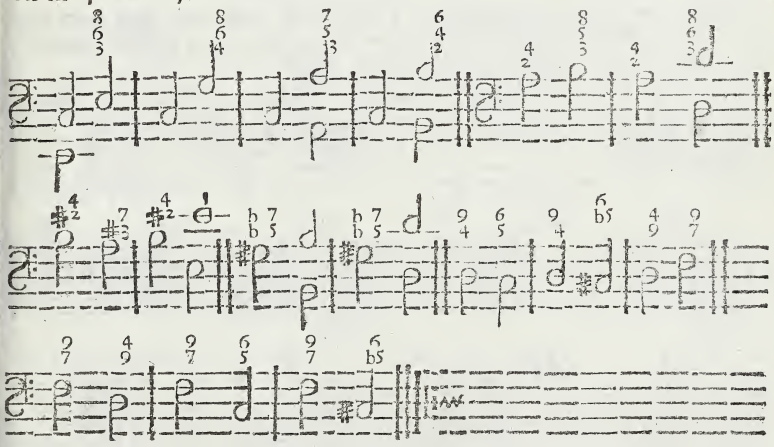




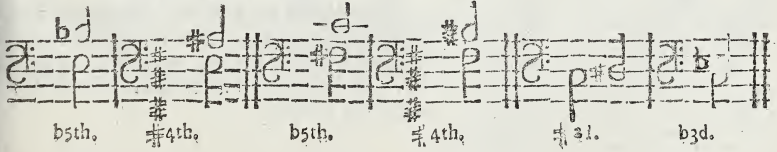

5 6 6 6 6 5 #3
6 7 6 7 6 9 6 7 6 6 43
6b5 9 8 6 5 7 b 7 b 5 5 43 9 8 4 3
9 8 7 6 765 7 6 3 4 4 3

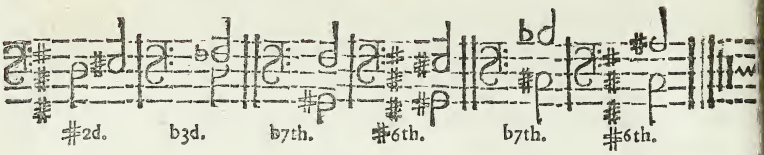
To make ſome Chords eaſie to your memory, you may obſerve as follows: A common Chord to any Note makes a 3d. 6th. and 8th. to the 3d. above it, or 6th. below it. A common Chord makes a 4th. 6th. and 8th. to the 5th. above it, or a 4th. below it. A common Chord makes a 3d. 5th. and 7th. to the 6th. above it, or a 3d. below it. A common Chord makes a 4th. 6th. and 2d. to the 7th. above it, or a 2d. below it.

A 2d. and 4th marked makes a common Chord to the Note above it, obſerving the 5th. perfect or imperfect, according to the Key, as alſo an 8th. 3d. and 6th. to the 4th. above it, or 5th. below it. A *Sharp* 7th. marked, where the *Baſs* lies ſtill makes 8th. 3d. and *ſharp* 6th. to the Note above it, and 5th. 7th. and *ſharp* 3d. to the Note below it. An extream *ſharp* 2d. and 4th. marked on a *Flat* Note, makes *ſharp* 3d. 5th. and 7th. on the half Note below it, as alſo a *ſharp* 6th. 8th. and 3d. to the *ſharp* 4th above it, or *flat* 5th below it; the *flat* 5th. and extream *flat* 7th. marked on a *Sharp* Note, makes 3d. *flat* 5th. and 8th. to the 3d. above it, or the 6th. below it, as alſo an 8th. 3d. and 6th. to the *flat* 5th. above it, or *Sharp* 4th. below it. The 4th or 9th. mark'd is the perfect 5th. 6th. and 3d. on the whole Note below it, and the *flat* 5th. 6th. and 3d, on the half Note below it, as alſo 3d. 7th. and 9th to the 3d. above it, or 6th. below it, the 9th. and 7th mark'd is the 5th. 9th. and 4th. on the 3d. below it, and the 6th. 3d. and perfect 5th. to the perfect 4th. below it, or the 5th. above it, and 6th. 3d. and *flat* 5th. on the perfect 4th. below it.

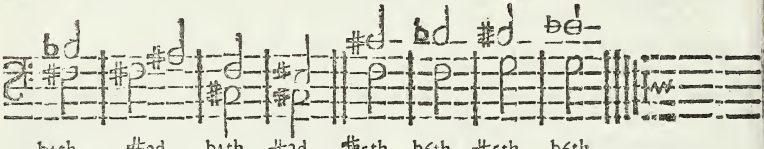


The *flat* 5th. and *ſharp* 4th. the extream *ſharp* 2d. and *flat* 3d. The extream *flat* 7th, and *ſharp* 6th. upon any fretted Inſtruments, or Harpſicord. without quarter Notes, are the ſame thing in diſtance, yet the diſtinction is as follows





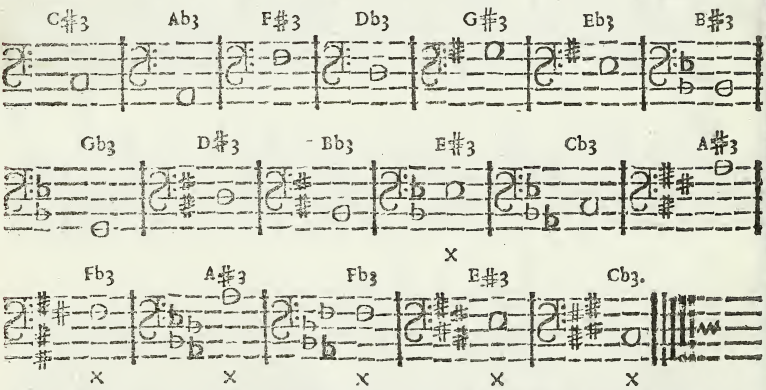
There are ſome other Chords of the ſame kind, *Viz.* the extream *flat* 4th. being the ſame as the *ſharp* 3d. and the extream *ſharp* 5th. the ſame as a *flat* 6th. but theſe Chords are only uſeful in three Parts, and will not admit a 4th. the diſtinction is as follows,



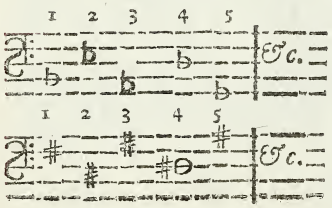
This extream *flat* 4th. admits a 6th. for the ſecond Part and is reſolv'd into the third, and the 6th. into the *flat* 5th. The extream *ſharp* 5th. admits for the ſecond Part a third.

Of Tranſpoſition.

Before any one can pretend to Tranſe-poſe from one Key into another, it is neceſſary they ſhou'd know all the *Flats* and *Sharps* naturally belonging to all, at leaſt the Practicable Keys.



Note: The Keys which are mark'd with a Croſs under them are ſeldom uſed.

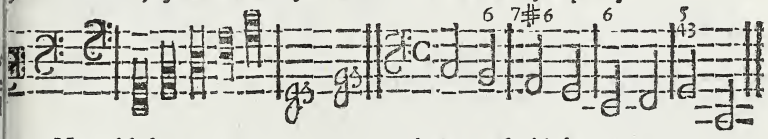


Additional flats *and* ſharps *in Order.*

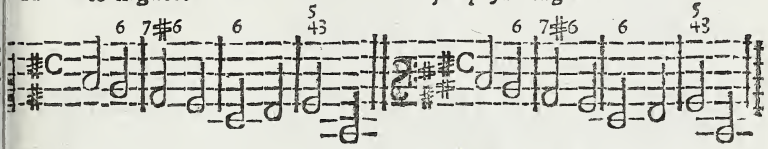
The reaſon why I call the *Flats* and *Sharps* One, Two, Three, *&c.* is becauſe where *B* is *flat E* may not, but where *E* is *flat B* muſt. The ſame reaſon holds good for *ſharps.*

Next it is requisite to be acquainted with the several *Cliffs* and their Removes, and last observe, that all *Flat* Keys must be Transpos'd into *Sharp* Keys, and *Sharp* into *Flat* ones: Which Keys are known according to their 3d. which is either *Flat* or *Sharp*.

faut Cliffs. *C solfaut* Cliffs. *G solreut* C. The Natural *sharp* Key.

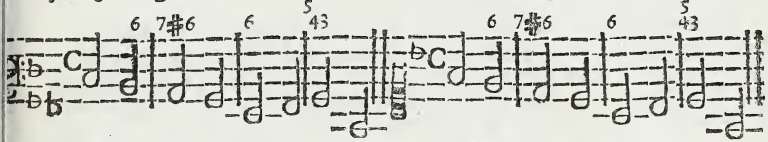


A Note higher.



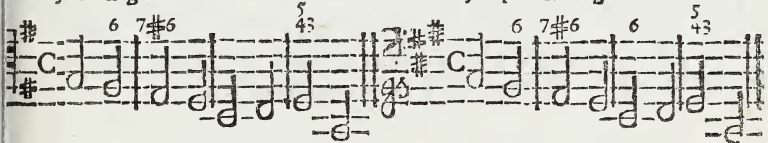
A *sharp* 3d. higher.

A *flat* 3d. higher.



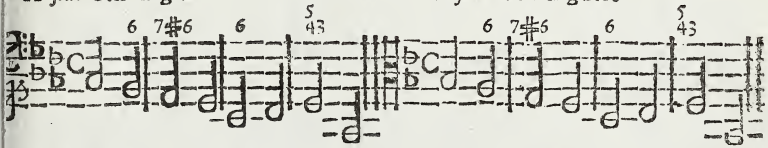
A 4th. higher.

A 5th. higher.



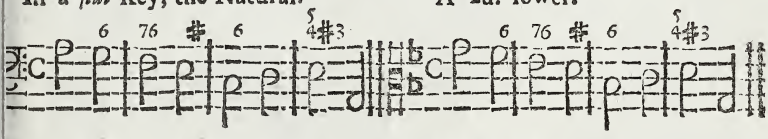
A *sharp* 6th. higher.

A *flat* 6th. higher.



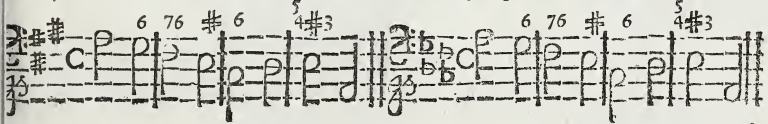
A *flat* 7th higher.

In a *flat* Key, the Natural.



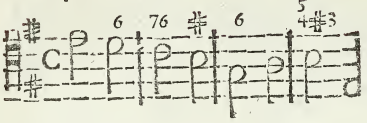
A 2d. lower.

A *flat* 3d. lower.

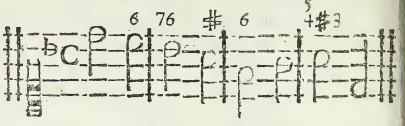


A *sharp* 3d. lower.

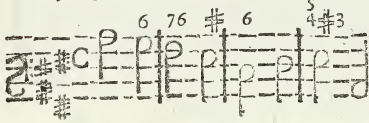
A 4th. lower.



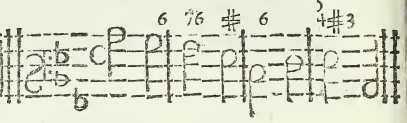
A 5th. lower.



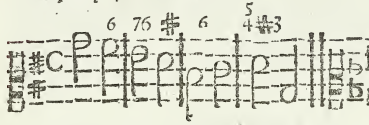
A *ſharp* 6th, lower.



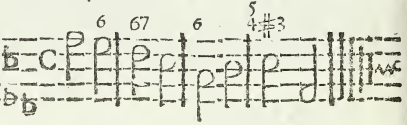
A *flat* 6th. lower.



A *ſharp* 7th. lower.



A *flat* 7th. lower.

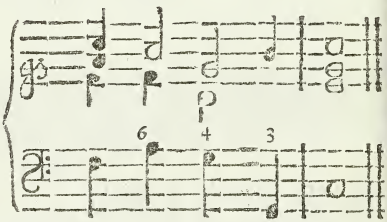


You are to obſerve what *Flats* or *Sharp*, belong to all the Keys, and imagine the *Cliff* that puts you in the Key you have a mind to Play in; and what you find too high or two low, according to the Compaſs of the Inſtrument you play on, you muſt Tranſpoſe an 8th. higher, or lower which is eaſie enough to be done.

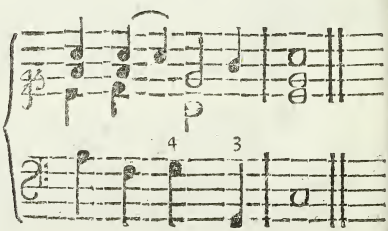
Of Diſcords, *how many ways they may be prepar'd and reſolv'd.*

The 4th. when joyn'd with a 5th. or 6th. and is generally reſolv'd into the third, may be prepar'd by a 3d. 5th. 6th. or 8th.

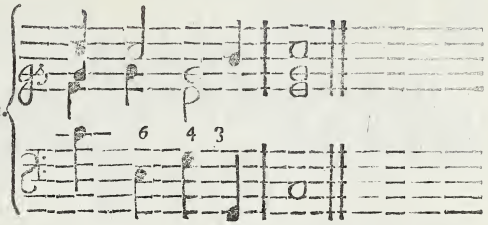
The 4th. prepar'd by a 3d. and Reſolv'd into a 3d.



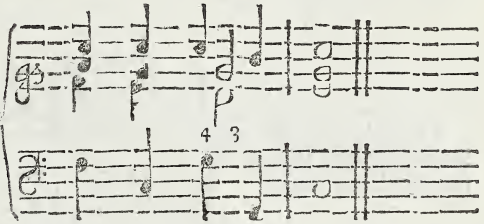
The 4th. prepar'd by a 5th and Reſolv'd into a 3d.



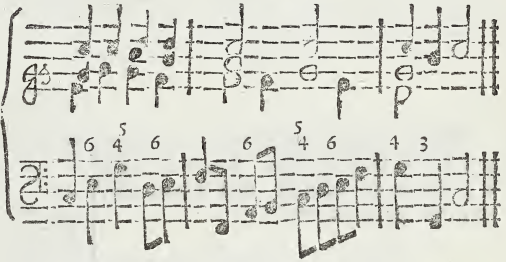
The 4th. prepar'd by a 6th. and Reſolv'd into a 3d.



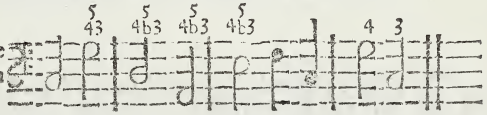
The 4th. prepar'd by an 8th. and Reſolv'd into a 3d.



The 4th. on occaſion Reſolv'd into a 6th.

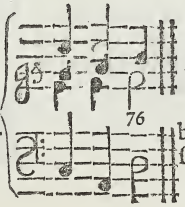


The 4th Reſolv'd into the 3d. ſeveral times before you come to the *Cadence*.

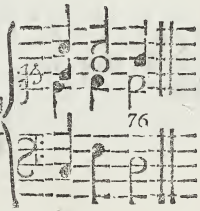


The 7th. may be prepar'd by a 3d. 5th. 6th. 7th. or 8th. The 7th. when the *Baſs* lies ſtill Reſolves into the 6th. and when the *Baſs* falls Five Notes, or riſes four Notes it Reſolves into the 3d. The 7th. ſome times Reſolves into a 5th. and then it is in order to a *Cadence*; ſo that the *Baſs* riſes one Note. I have ſeen the 7th. Reſolv'd into an 8th. but it ſounds ſo like two 8ths, that it makes me utterly againſt it.

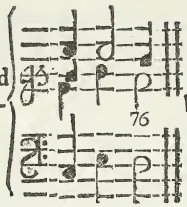
The 7th. prepar'd by a 3d. and Reſolv'd into a 6th.



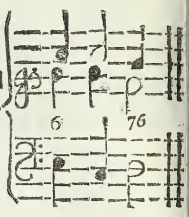
The 7th. prepar'd by a 5th. and Reſolv'd into a 6th.



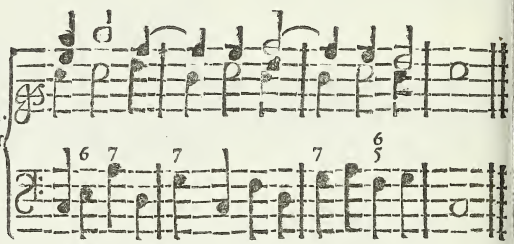
The 7th. prepar'd by a 6th. and Reſolv'd into a 6th.



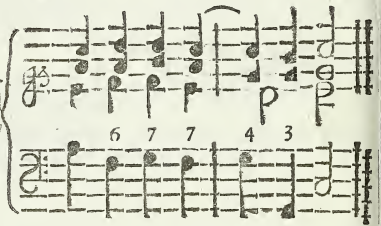
The 7th. prepar'd by an 8th. and Reſolv'd into a 6th.



Example of the 7th. Reſolving into the 3d. or the 5th. ſome times.

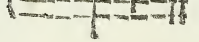


There is ſome times two 7ths. Compos'd one after another, but it is call'd a Licence in Muſick and commonly in order to a *Cadence.*

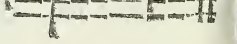


The 9th. is generally prepar'd by a 3d. or a 5th. and it may be by a 6th. or 8th. but not ſo naturally. The 9th when the *Baſs* lies ſtill, Reſolves into the 8th. The 9th. when the *Baſs* falls a 3d. Reſolves into a 3d. The 9th. when the *Baſs* riſes a 3d. Reſolves into a 6th. The 9th. may Reſolve into a 5th. but not ſo naturally as the other, and then the *Baſs* riſes four Notes.

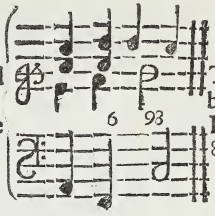
The 9th. prepar'd by a 3d. and Reſolv'd into the 8th.



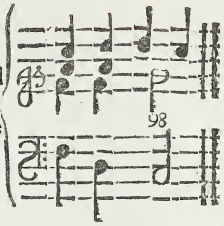
The 9th. prepar'd by the 5th. and Reſolv'd into the 8th.



The 9th. prepar'd by a 6th. and Reſolv'd into the 8th.

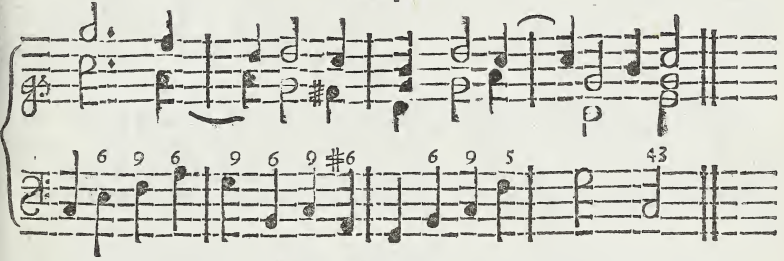


The 9th. prepar'd by the 8th. and Reſolv'd into the 8th.



Of the 9th. Reſolving into the 3d. and 6th. but rarely into a 5th.

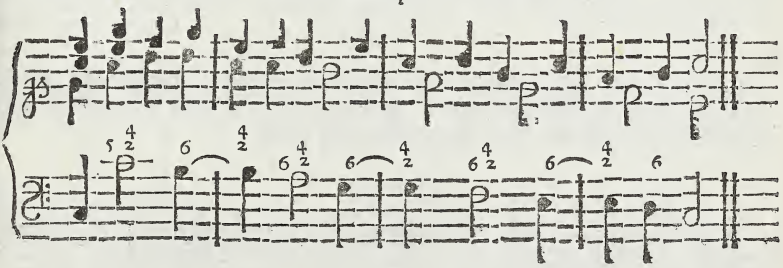
Example.



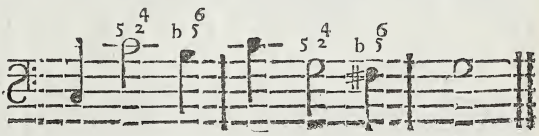
The *Flat* 4th. and 2d. and *Sharp* 4th. and 2d. is brought in when the *Baſs* in a driving Note deſcends a half or whole Note, the *Sharp* 4th. always Reſolves into the 6th. as does generally the *Flat* 4th. but ſome times with the *Flat* 5th. the 2d. Reſolves into the 3d.

Where the ſeveral driving Notes deſcend by degrees.

Example.

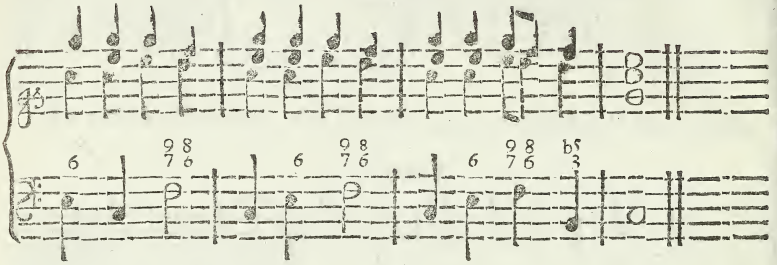


Another Example.



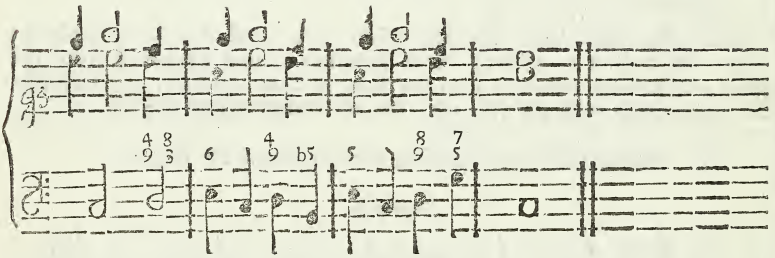
The 9th. and 7th. mark'd above one another, may be prepar'd by the 3d. and 8th. and Reſolv'd into the 8th and 6th. the *Baſs* lying ſtill and ſome times is artificially into the *Flat* 5th. and 3d. and the *Baſs* falls a *Flat* 5th.

Example.



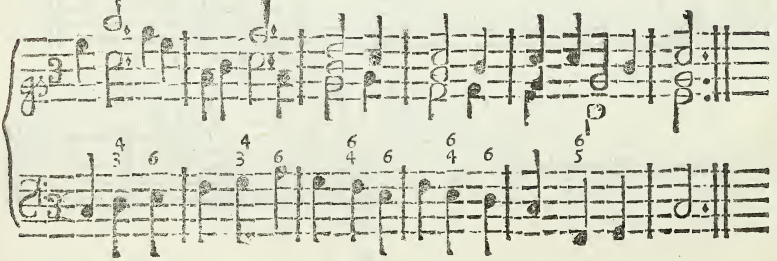
The 4th. and 9th mark'd one above another is beſt prepar'd by the 3d. and 5th. and Reſolv'd into the 3d. and 8th, the *Baſs* lying ſtill, ſome times artificially into the *Flat* 5th. and 3d. the *Baſs* falling a 3d. and ſome times into a 7th. the *Baſs* riſing four Notes contrary to the *Treble.*

Example.



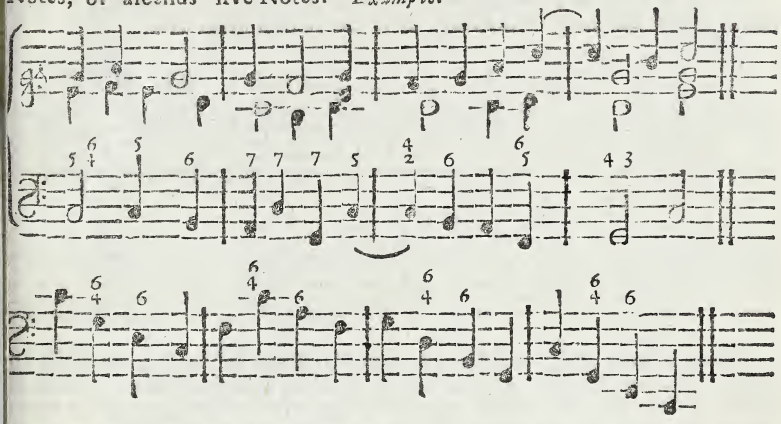
The 4th. and 3d. mark'd one above another is commonly us'd when the *Baſs* aſcends by degrees, the 6th. and 4th. with a 2d. is commonly us'd when the *Baſs* deſcends by degrees.

Example.

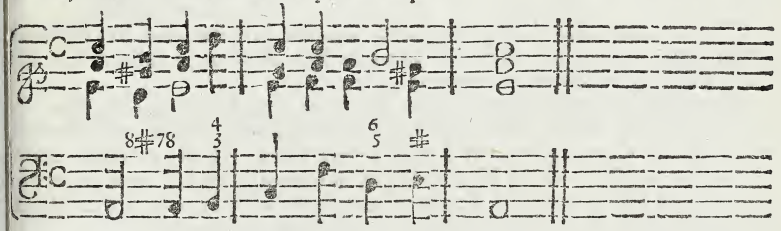


The

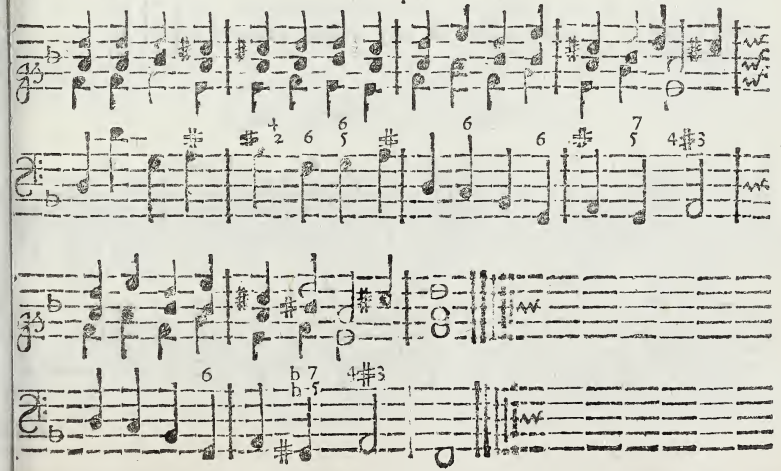
The 6th. and 4th. where the 8th. is joyn'd is commonly us'd when the *Baſs* lies ſtill in a *Sharp* Key, or when the *Baſs* either deſcends four Notes, or aſcends five Notes. *Example.*



The *Sharp* 7th. when accompany'd with a 2d. and 4th. is us'd, when the *Baſs* lies ſtill in a *Flat* Key. *Example.*

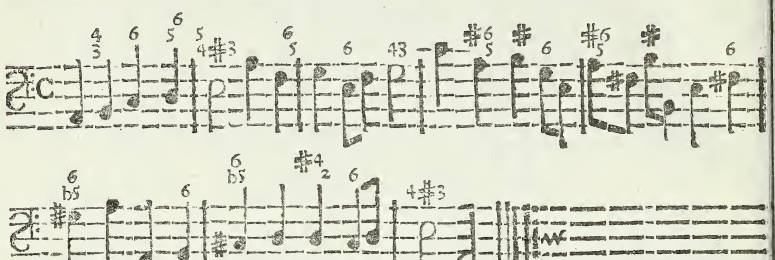


The extream *Sharp* 2d. and 4th. generally prepares a *Cadence.* The 5th. and 7th. and the *Flat* 5th. and extream *Flat* 7th. are generally the fore runners of a *Cadence.* *Example.*



The perfect 5th. and 6th. joyn'd is commonly us'd as the 7th. and 5th. before a *Cadence*, as alſo when the *Baſs* deſcends by 3ds.

The *Flat* 5th. may be joyn'd to any *Sharp* Note that requires a 6th. unleſs it be contrary to the Key, or it be mark'd otherwiſe.



The extream *Sharp*, and the extream *Flat* Notes belonging naturally to either *Flat* or *Sharp* Key: The extream *Sharp* in a ſharp Key, is the half Note below the Key: The extream *Sharp* in a flat Key, is the Note above the Key, unleſs taken off by an additional *Sharp*: The extream *Flat* in a *Sharp* Key, is a 4th. above or the 5th. below the Key: The extream *Flat* in a flat Key, is a 3d. below or a 6th. above the Key.

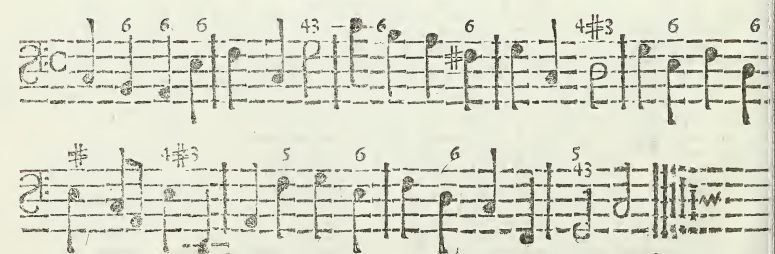
The extream *Sharp* being too harſh, and the extream *Flat* too luſcious unleſs taken off by an additional *Sharp* or *Flat*, or what is excepted in the following Rules ought to be doubled.

On either extream Sharp or Flat Note, or any extraordinary *Sharp* or *Flat* Note out of the Key, that requires a common Chord, you double the 8th. in Compoſition, or Playing four Parts. If the extream *Sharp* or an extraordinary ſharp Note requires a natural *Flat* 6th. you leave out the 8th. in four parts, and Compoſe, or Play two Sixes and one third or two thirds according as the *Baſs* is too high, or too low.

If the extream *Flat* or any extraordinary flat Note requires a 6th. inſtead of double Sixes, or double thirds, you may Compoſe, or Play in four Parts.

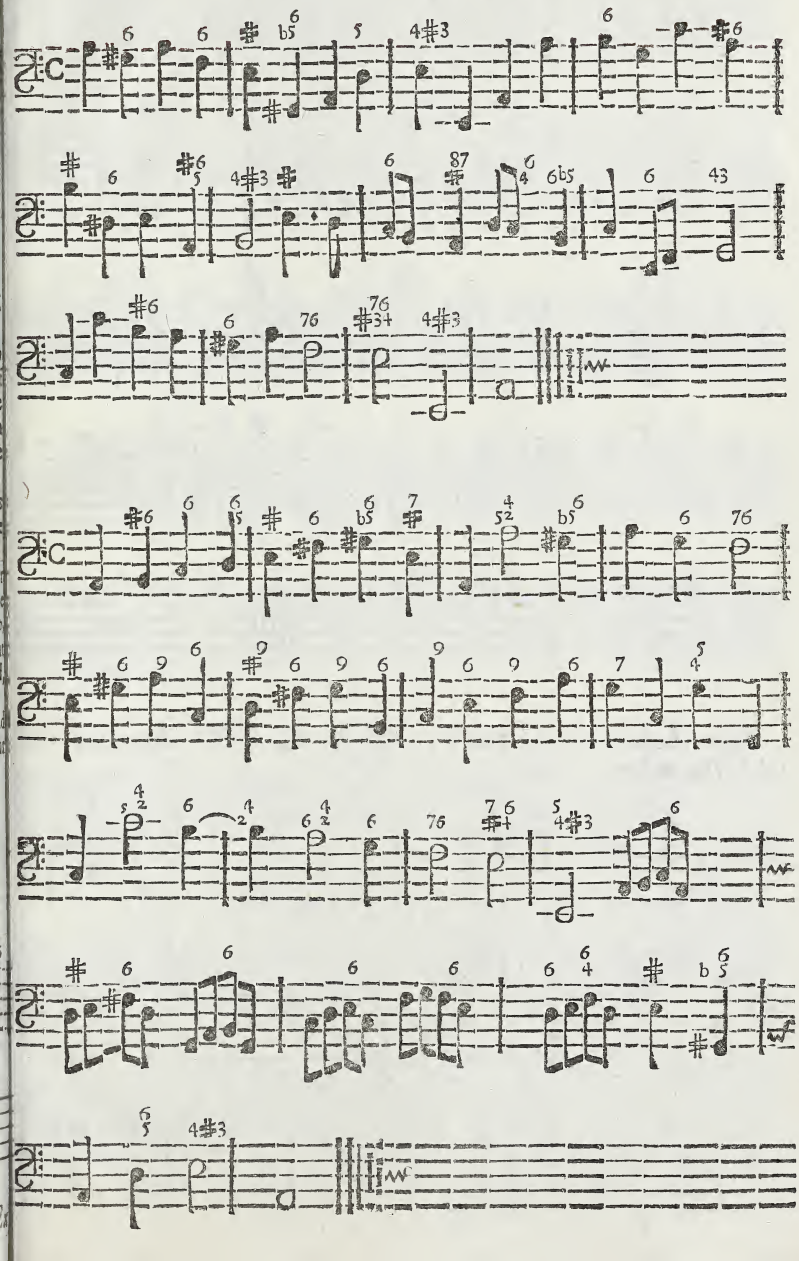
Where the extream *Flat*, or an extraordinary flat Note happens to make a 6th. to any Note, never double that Sixth. { 8 6 3 | 3 8 6 | 6 3 8 |

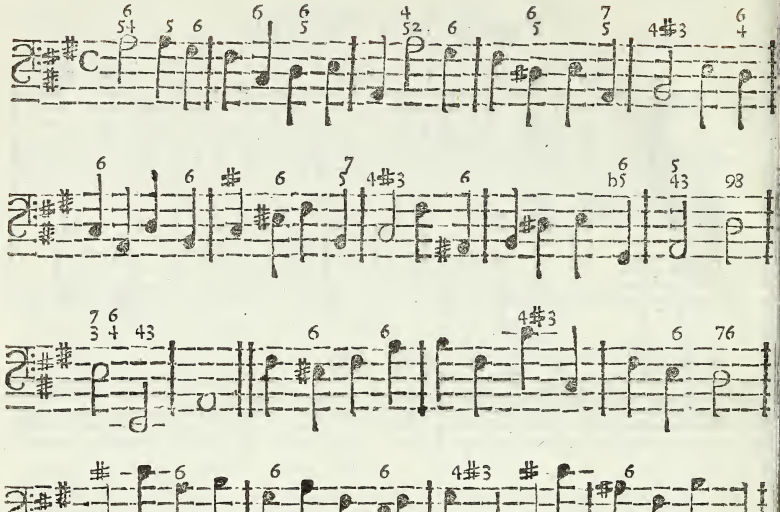
Example in a Sharp Key.



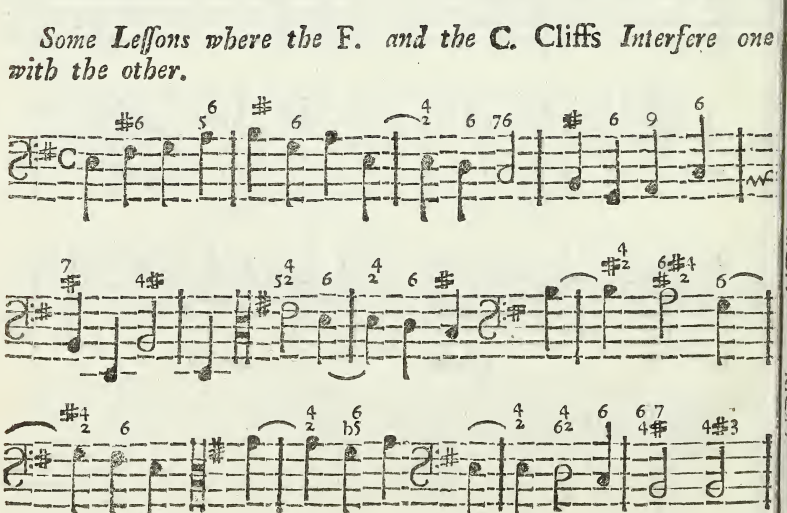
Ex

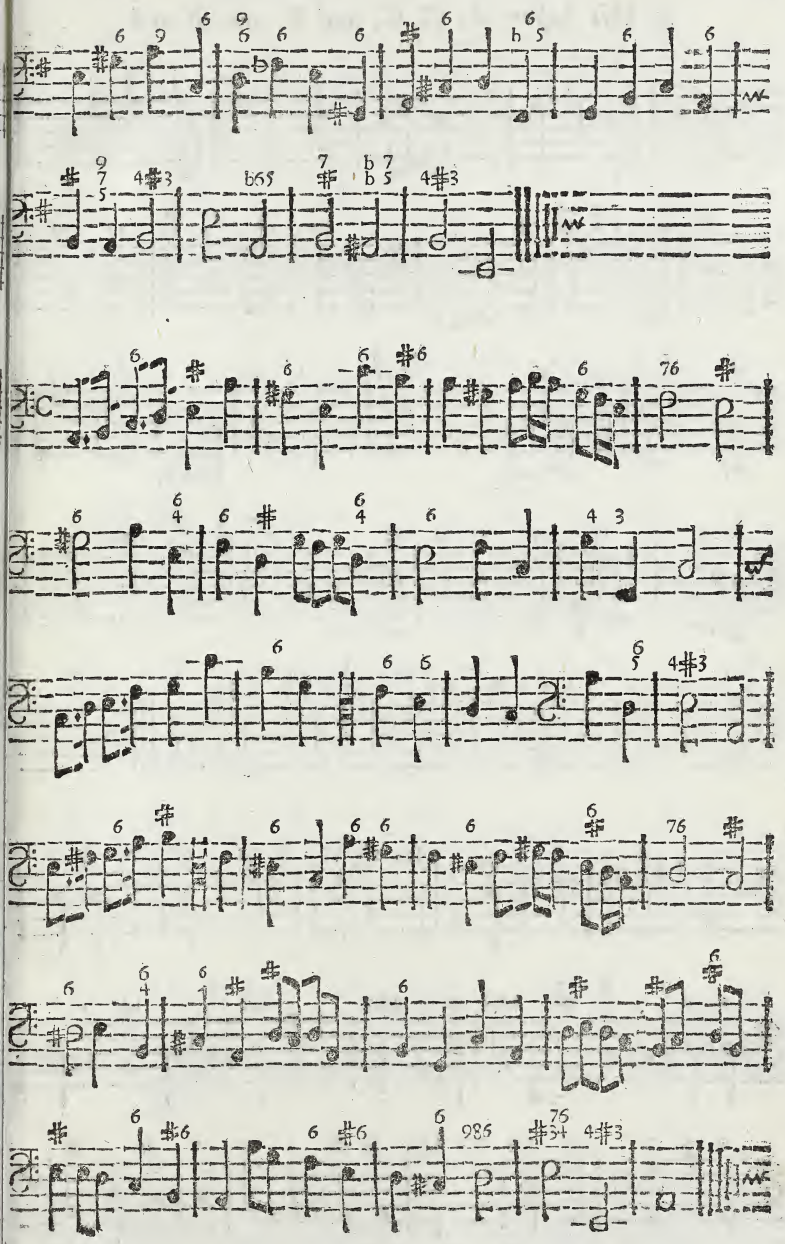
Example in a Flat Key.



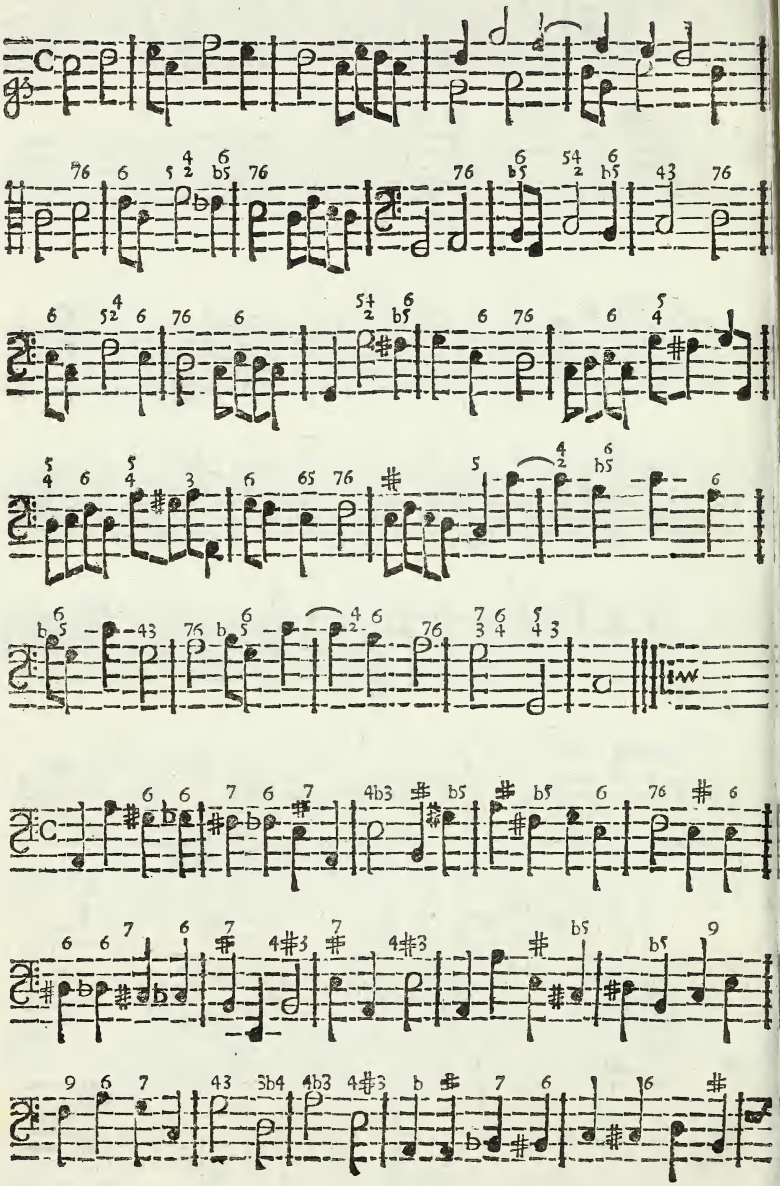


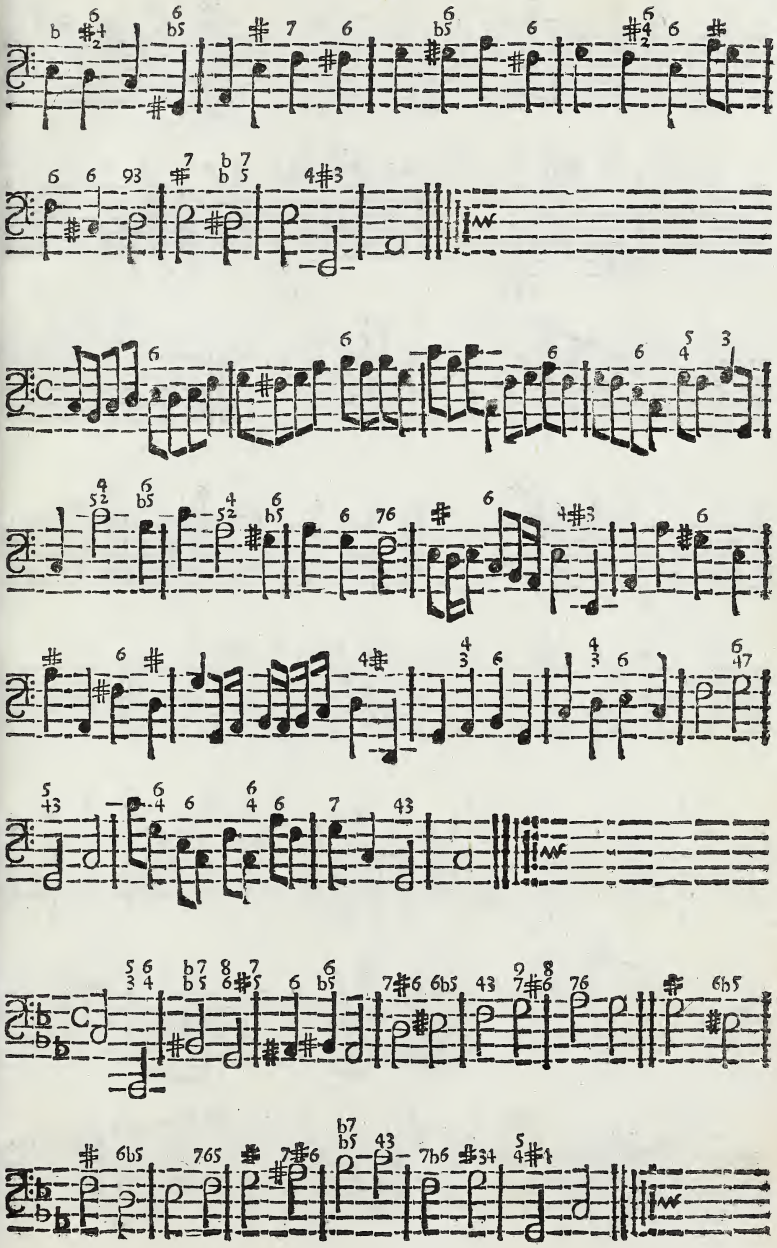
Some Leſſons where the F. *and the* C. Cliffs *Interfere one with the other.*

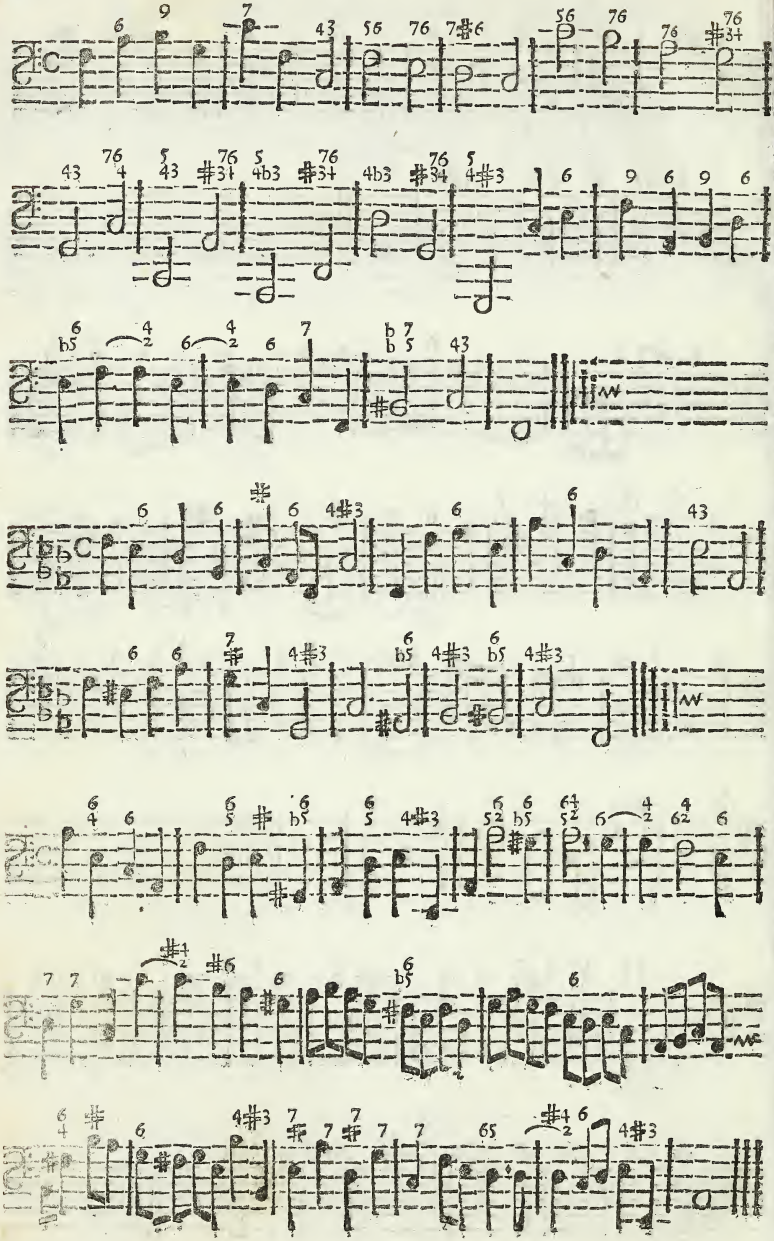


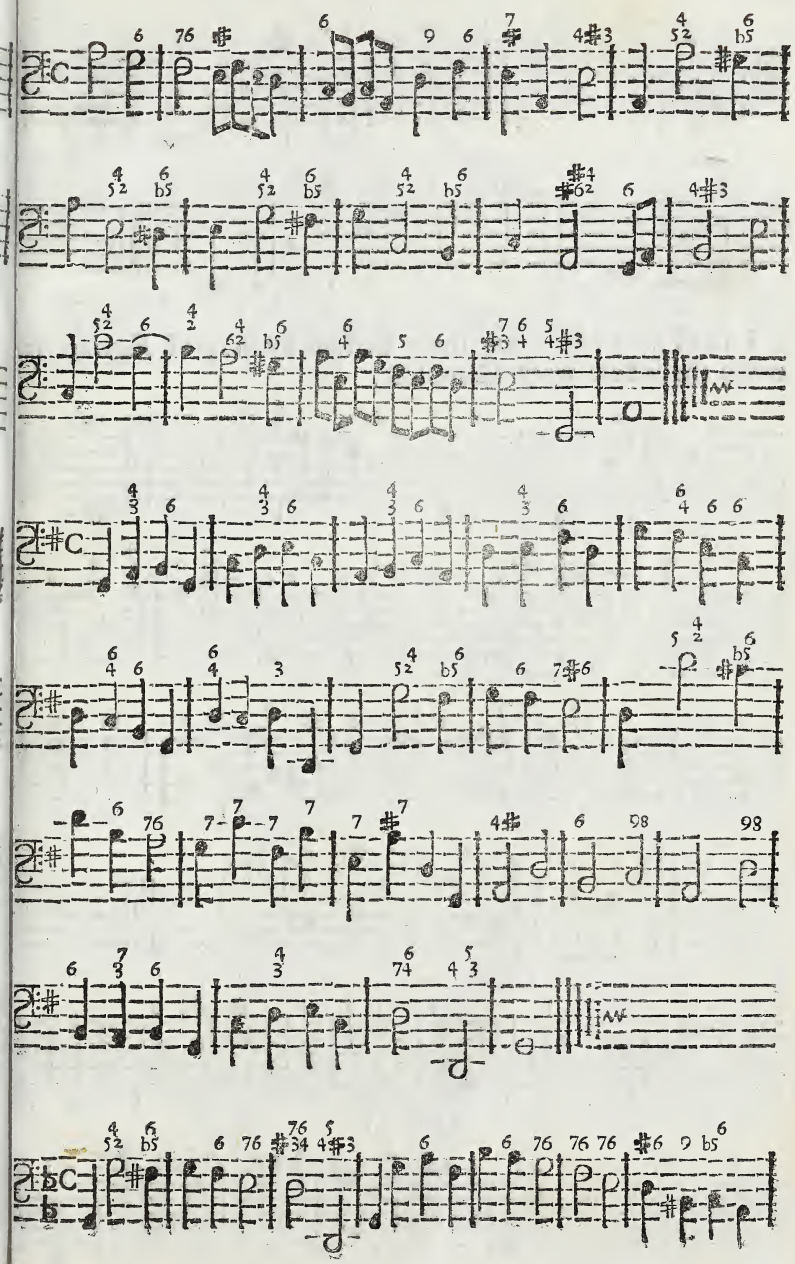


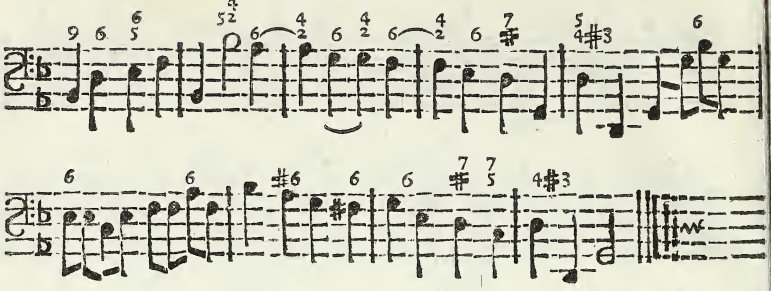
In this Leſſon the G, C, *and* F. *are all us'd.*



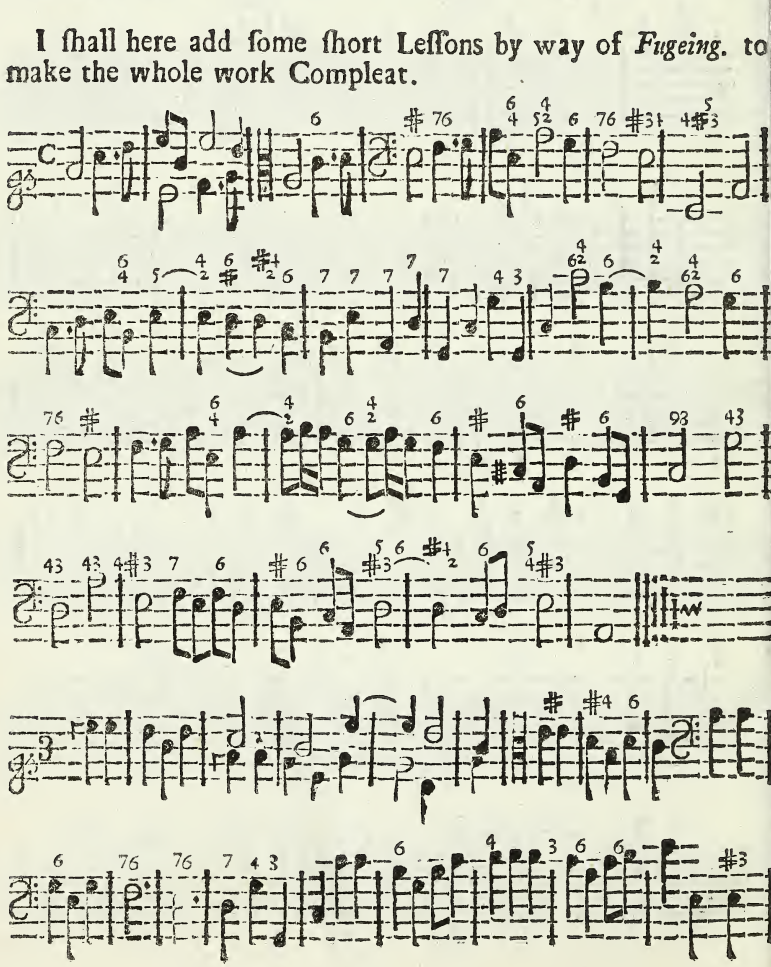


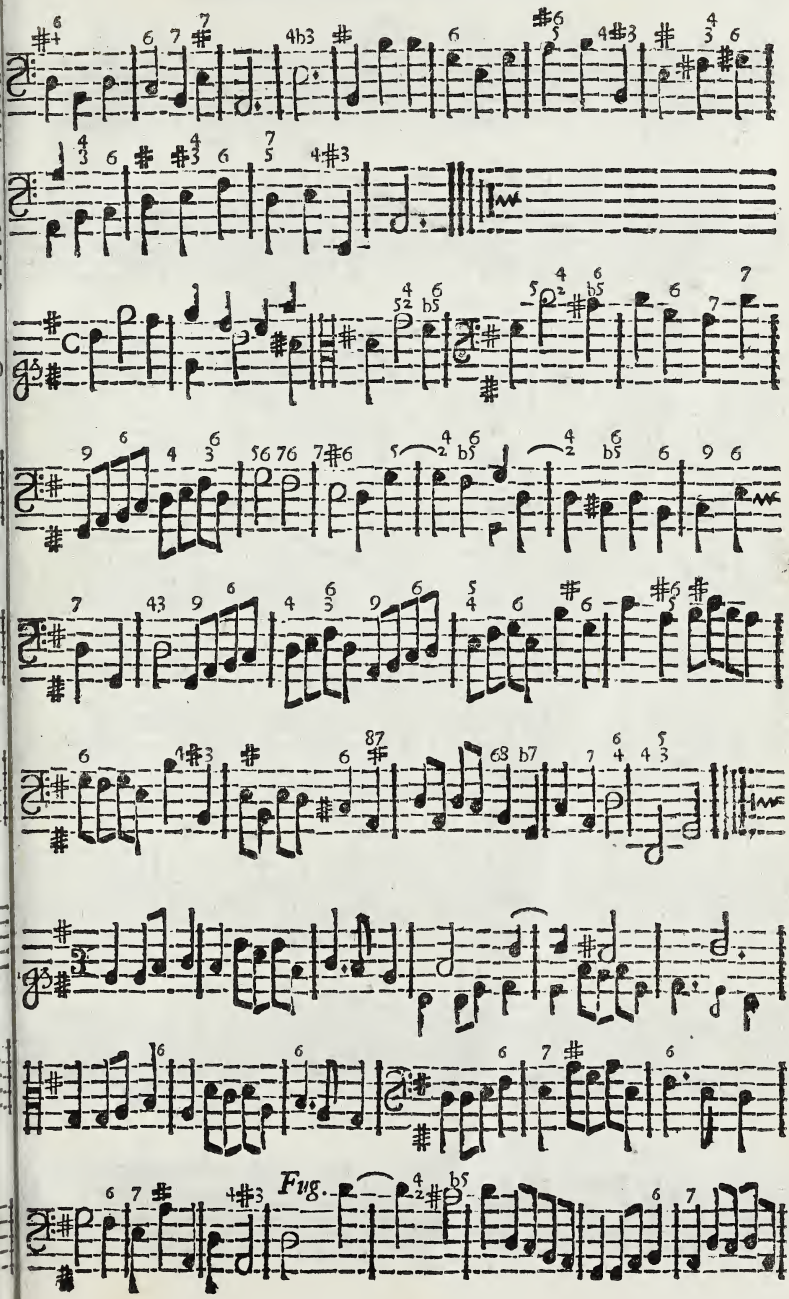






I ſhall here add ſome ſhort Leſſons by way of *Fugeing.* to make the whole work Compleat.

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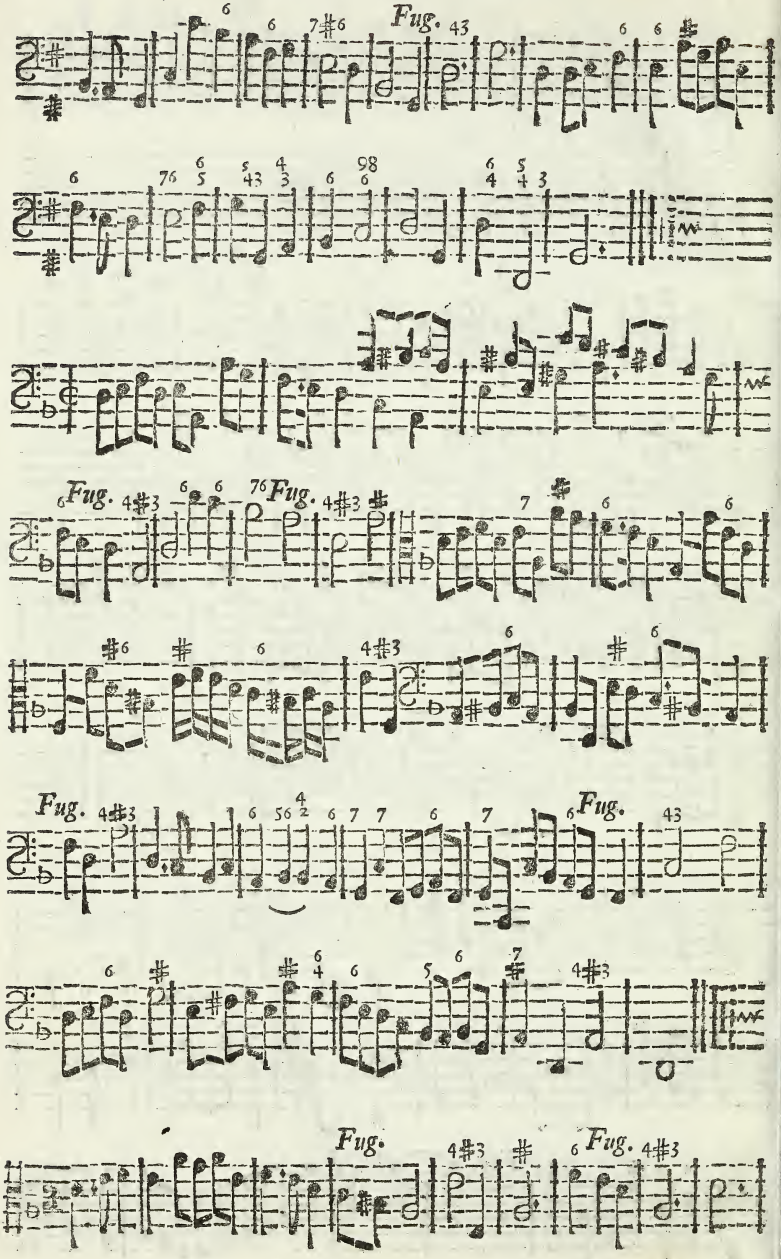
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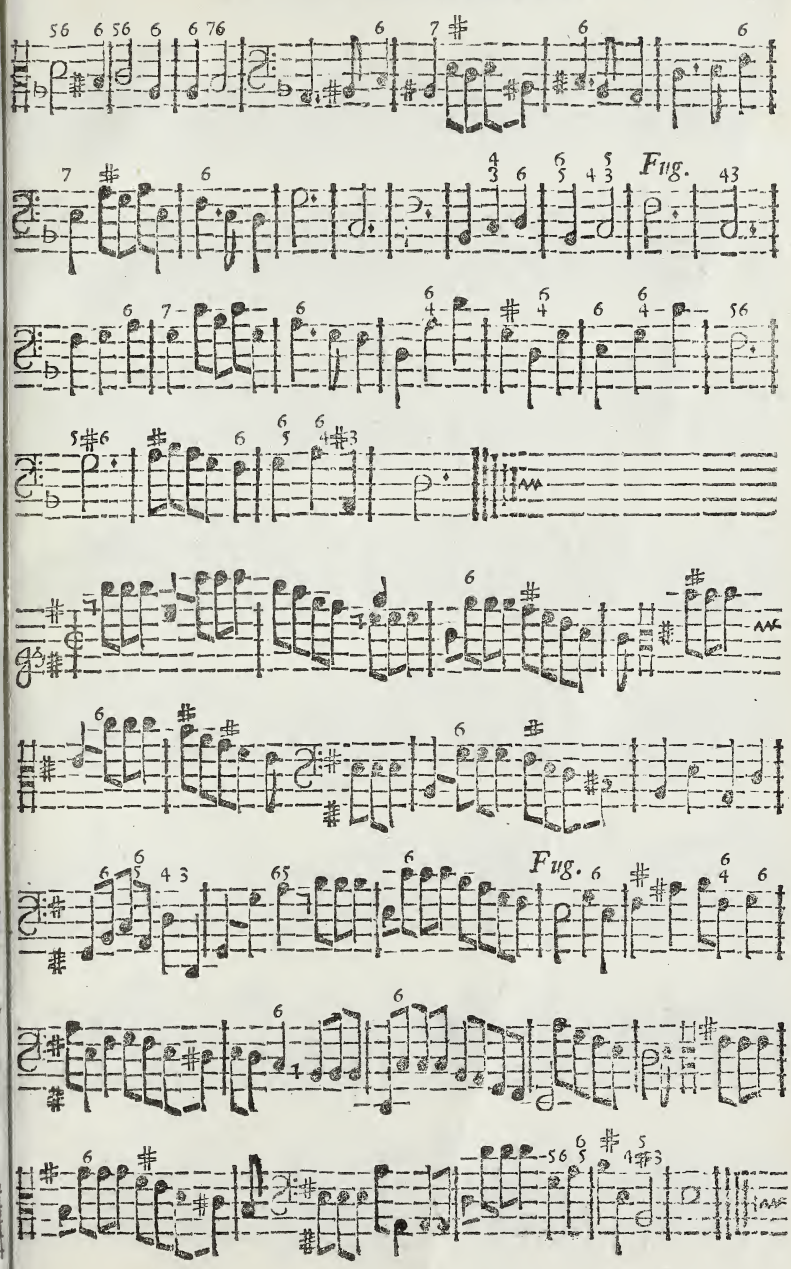
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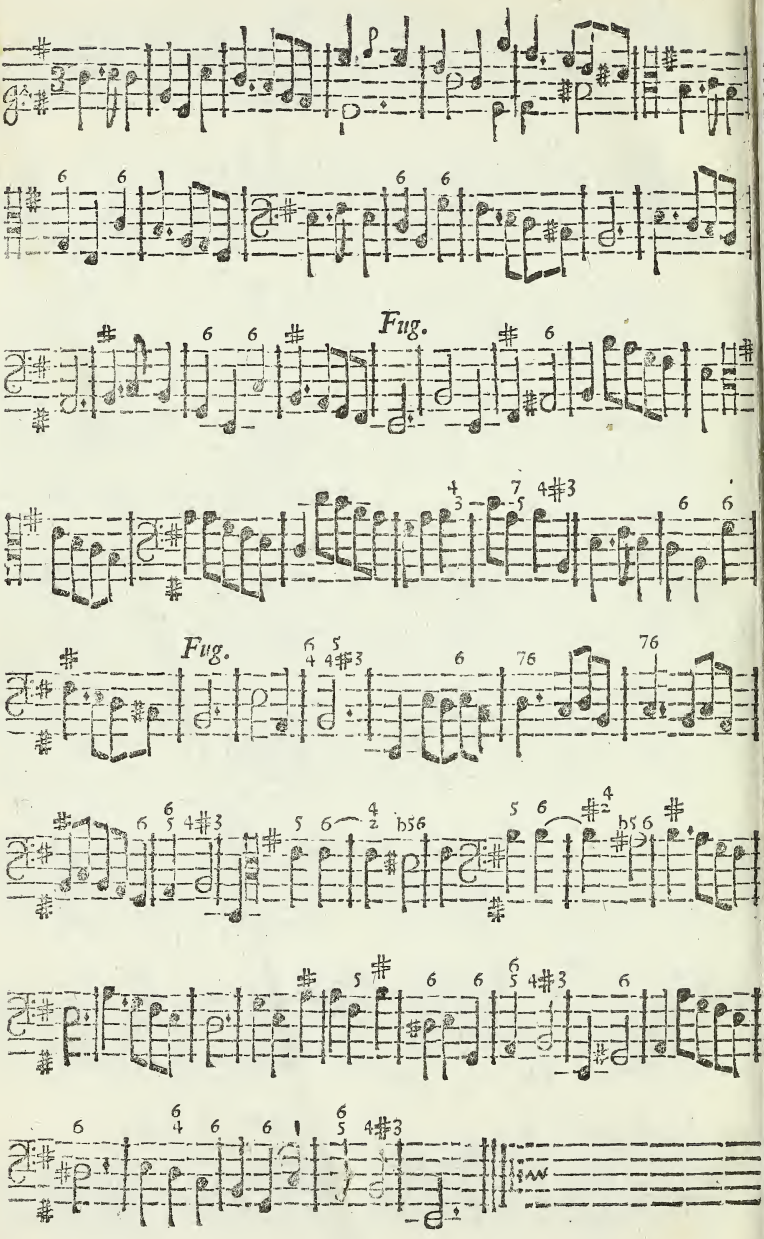
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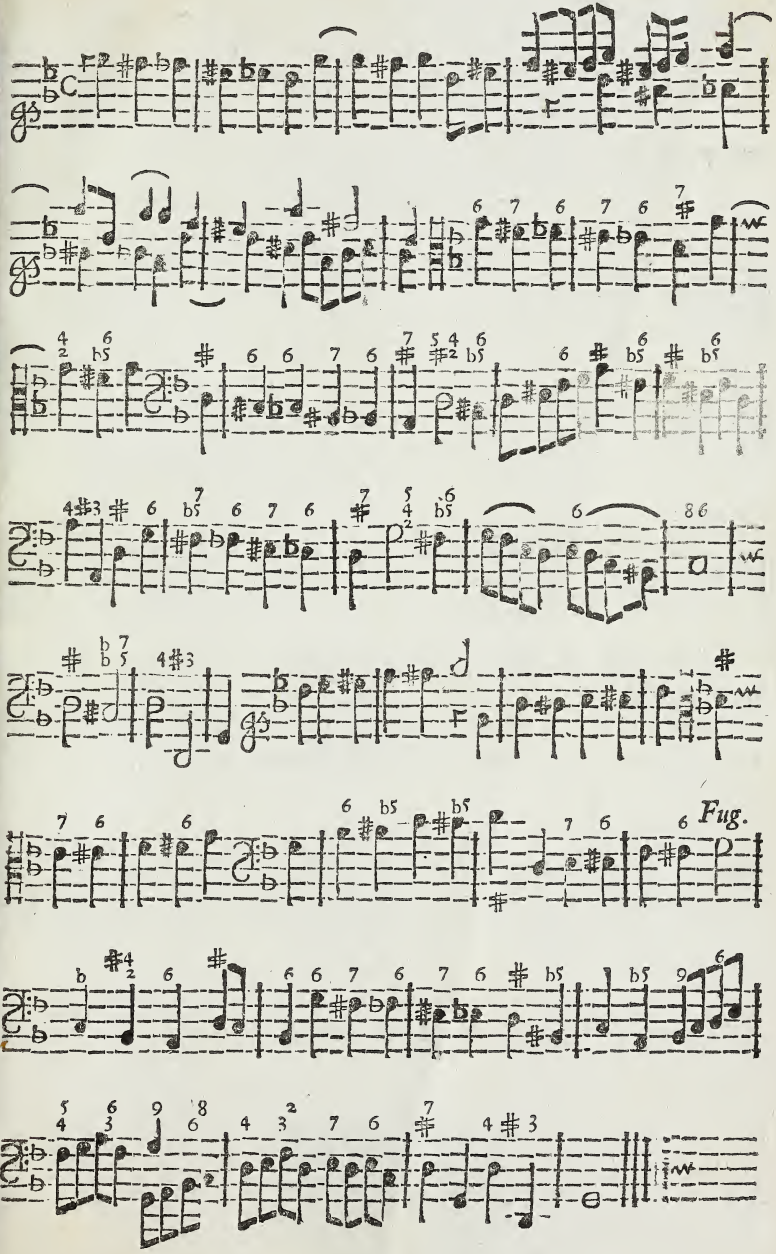
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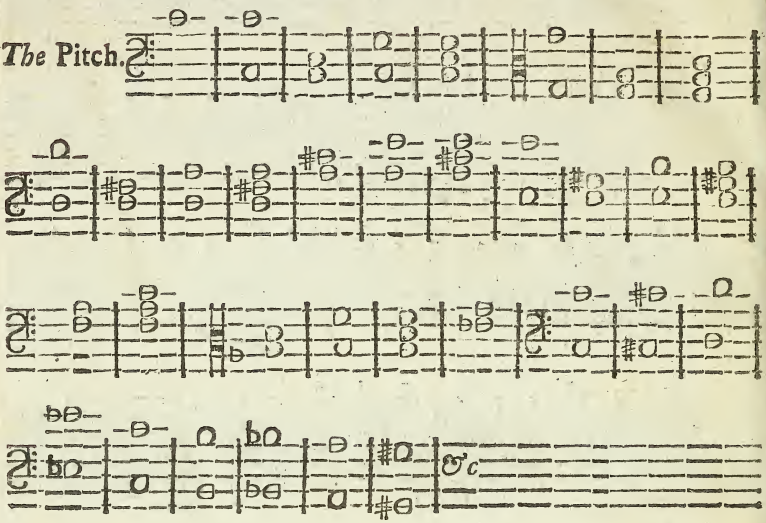
Rules for Tuning a HARPSICORD *or* SPINET.

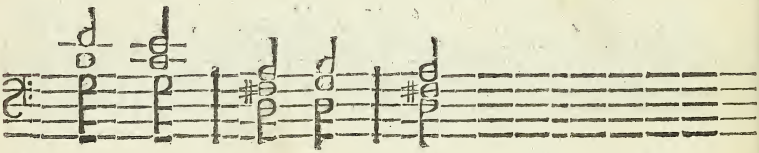
Tune the C-ſol-fa-ut *by a* Conſort *Fitch-pipe.*

The Pitch.



Obſerve all the Sharp Thirds muſt be as ſharp as the Ear will permit; and all Fifths as flat as the Ear will permit.

Now and then by way of Tryal, touch Uniſon Third, Fifth, and Eights; and afterward Uniſon Fourth and Sixth.



F I N I S.

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